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SUMMARY

The method for estimating amount of precipitation in a present day quality control system (KVALM/KVALU) is analysed. The use of weighted linear estimation is improved by computing correctional factors eliminating the bias and a new set of reference stations reducing the standard error by approximately 20%.

The problem of embedding the weighted linear estimators in a quality control system is discussed. Some ideas for further development along with numerical results from the experiments are included.

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A METHOD OF WEIGHTED LINEAR ESTIMATION APPLIED TO QUALITY CONTROL OF PRECIPITATION VALUES

1. INTRODUCTION

By October 1993 the number of precipitation stations in use in Norway was 733. Observations from these stations are recorded on precipitation cards and sent to the Norwegian Meteorological Institute (DNMI) every week. All stations observe rainfall at 07 a.m. (08 a.m.) c.e.t. in addition to snowfall, snow cover and weather conditions during the periods 08:00 a.m. - 01:00 p.m., 01:00 - 07:00 p.m. and 07:00 p.m. - 08:00 a.m. each day. Among the stations there are 56 that observe less frequently. The total number of data to be controlled each week is approximately 25000.

In this report only rainfall is analysed. Rainfall is collected into cylinders, and the daily amount of precipitation is measured in tenth of millimetres.

In 1945 a general description of methods to use in quality control was given by Head of Institute at the time, Th. Hesselberg [1]. In 1961 DNMI put its first digital computer to use, and a new set of rules regarding how to effectuate quality control and interpolation before punching data was given by Head of Climatology Division at the time, Thor Werner Johannessen [2]. From then on there has been a continous research and improvement of methods for use in correction or interpolation of geophysical data. Some of this work is documented, confer [3, 4, 5, 6].

This report makes an effort out of analysing and improving the presently used KVALM/KVALU-system for quality control of rainfall for precipitation stations developed by E. Borvik at the Climatology Division [7, 8]. This effort is part of a quality control improvement programme described in [9].

The report is structured as follows: Section 2 gives a description of the basic philosophy behind the present day estimation method. Section 3 describes an improved version of the method. Section 4 explains how the methods may be used in quality control. Section 5 contains some ideas for further improvement of the system.

Statistical concepts used throughout the text can be found in any introductory treatment on statistical concepts and methods, for example Bhattacharyya & Johnson [10]. In different parts of the text there are references to tables holding geographical and geophysical information. These are constructed as relations in a relational database system, confer [11, 12] for further details.

I would like to thank Einar Borvik for explaining the KVALM-system and Eirik J. Førland for his critical reading of the manuscript.

2. WEIGHTED LINEAR ESTIMATION

Given a test station observing rainfall each day at 07 a.m. and several surrounding stations, the aim of this exposition is to use observations from the surrounding stations to estimate the rainfall on the test station.

The introductory subsection introduces the statistical tools of linear estimation to be used throughout the text, next subsection gives a theoretical outline of the present day estimation method. The last subsection consist of summary statistics evaluating the method and giving indications in what directions it should be improved.

2.1 Elements of estimation theory

The precipitation at a given station can be regarded as a random variable defined on the sample space of all real numbers greater or equal zero.

Definition 2.1.1

Let $\Omega = [0,\infty)$ be a sample space (with a Borel sigma-field on Ω[1]) modelling the daily amount of rainfall at a given precipitation station with a unit of one tenth of a millimetre.

A random variable X modelling the measured amount of rainfall is defined as

$$X(\omega) = \begin{cases} -1 & \text{if } \omega = 0 \\ \lceil \omega - \tfrac{1}{2} \rceil & \text{if } \omega > 0 \end{cases} \qquad (2.1.1)$$

where $\lceil a \rceil$ denotes the least integer greater or equal a.

The value -1, meaning absolutely no precipitation in definition 2.1, is discussed in section 2.2.2 below.

The technique of rounding numbers, in order to operate on a discrete sample space

$$\Omega_X = \{X(\omega) | \omega \in \Omega\} \qquad (2.1.2)$$

associated with each random variable X, is used as a convention throughout the text, i.e. if nothing else is stated it can be assumed that the numbers being manipulated are integers.

[1]Events are constructed as intersections and unions of the intervals $[0,a)$ and (b,c) where a, b and c are arbitrary real numbers, confer [13] or [14].

The objective of estimating an unknown random variable X is to construct an other random variable $\hat{X}$ from available information which is assumed to be given in the form of a list of random variables $Y_1, Y_2, \ldots, Y_n$. By combining this information in some way one tries to make the random variable reflect the behaviour of the unknown variable as closely as possible, or more precisely stated:

Definition 2.1.2

Given a random variable X and random variables $Y_1, Y_2, \ldots, Y_n$ that are related to X, a *linear estimator* $\hat{X}$ of X is a function

$$\hat{X} = \sum_{i=1}^{n} w_i Y_i . \qquad (2.1.3)$$

for some real numbers $w_1, w_2, \ldots, w_n$.

In the case of estimating rainfall, X is the daily amount of precipitation on a given station and the sample $Y_1, Y_2, \ldots, Y_n$ is the daily amount of precipitation on surrounding stations.

The variables $Y_1, Y_2, \ldots, Y_n$ will be denoted the *predictors* in the problem of estimating X, a term usually connoted with regression analysis (confer [10], p. 338).

When applying (2.1.3) to the process of estimating areal precipitation the coefficients $w_1, w_2, \ldots, w_n$ are often referred to as weights, confer Dahlström et al. [15].

A major problem in constructing an estimator is to make sure that use of the estimator $\hat{X}$ in repeated samplings will not result in a systematic overestimation or underestimation of X. If the estimator has a tendency of predicting greater values than X it is said to have a positive bias, if it has a tendency for predicting less values than X it is said to have a negative bias.

Definition 2.1.3

The bias of an estimator $\hat{X}$ with respect to X is defined as

$$E(\hat{X} - X), \qquad (2.1.4)$$

The estimator is unbiased if

$$E(\hat{X}) = E(X) \qquad (2.1.5)$$

where $E(Y)$ refers to the expectation of Y.

If an estimator is unbiased, the next quality criterion to look for is how closely the estimates are to the correct values. A precipitation estimator being unbiased does not necessarily imply that the estimates are close to the correct precipitation, this fact is illustrated in [15], naming the phenomenon "stochastically biased".

In order to measure deviation between the estimated precipitation and the actual precipitation, the statistical concepts of standard error and maximum absolute error are needed.

Definition 2.1.4

By the standard error of an estimator $\hat{X}$ with respect to a random variable X the standard deviation of $\hat{X} - X$ is meant, i.e.

$$\text{S.E. } (\hat{X}) = \sqrt{E\left[(\hat{X} - X - E(\hat{X} - X))^2\right]} \qquad (2.1.6)$$

Definition 2.1.5

By the maximum absolute error of an estimator $\hat{X}$ with respect to a random variable X the value

$$\text{M.A.E.}(\hat{X}) = \sup_{\omega \in \Omega}\left\{\left|\hat{X}(\omega) - X(\omega)\right|\right\} \qquad (2.1.7)$$

is meant, i.e. the largest absolute difference ever to occur between the estimate and the actual value.

The concepts involved in definitions 2.1.3 to 2.1.5 are sometimes defined somewhat differently, using

$$\theta = \hat{X} - X \qquad (2.1.8)$$

as the estimator estimating the difference between the two random variables which is assumed to be a non-random numerical value, confer [10, p. 235f].

It should also be noticed that the formulas (2.1.6) and (2.1.7) can be viewed as the L_2 and L_∞ norms on the functional space of random variables defined by (2.1.1). In this sense the formulas measure the distance between the random variables according to the different topologies, confer [14].

2.2 Present day method of linear estimation

The present day method for estimating precipitation used in spatial quality control was designed and implemented by E. Borvik at DNMI about 1970, and has been continuously improved. Below is a description of the estimation method and an analysis of consistency and stability.

2.2.1 Description of the estimation method

The method for generating estimates for a given station consists of two steps. At first predictors are chosen, secondly the estimator is constructed as a linear combination of the predictors. The algorithm 2.2.1.1 below describes how the predictors and corresponding weights are chosen.

Algorithm 2.2.1.1

Let G be a two dimensional grid across a geographical area of interest consisting of m times n cells. Let **A** be a m times n integer matrix. Let **W** be a 7 times 7 matrix with entries

$$w_{i,j} = \begin{cases} 1 & \text{if } i=1 \vee i=7 \vee j=1 \vee j=7 \\ 2 & \text{if } i,j \in [2,6]^2 \wedge (i=2 \vee i=6 \vee j=2 \vee j=6) \\ 3 & \text{if } i,j \in [3,5]^2 \wedge (i=3 \vee i=5 \vee j=3 \vee j=5) \end{cases} \qquad (2.2.1.1)$$

and $w_{4,4} = 0$.

1) For each station with associated number K in operative use and there does not exist any $a_{i,j} = K$ in **A**
   If the component $a_{i,j}$ corresponding to the cell where K is situated is unoccupied **then**
      $a_{i,j}$ is assigned the value K
   else if there exists an unoccupied $a_{i+k,j+r}$ for some small $|k|$ and $|r|$ **then**
      $a_{i+k,j+r}$ is assigned the value K

2) For each non-negative $a_{i,j}$ its reference stations are defined as the set

$$\{a_{k,r} | k \in \{i-3,\ldots,i+3\} \cap [1,m] \setminus \{i\}, r \in \{j-3,\ldots,j+3\} \cap [1,n] \setminus \{j\}\} \qquad (2.2.1.2)$$

   and with weights given by the formula

$$v_{k,r} = w_{k-i+4,r-j+4} \qquad (2.2.1.3)$$

   corresponding to reference stations in (2.2.1.2).

In the figure 2.2.1.2 below the algorithm 2.2.1.1. is illustrated. The station 65600 HITRA in Sør-Trøndelag, in the center of the rectangular area, has four reference stations.

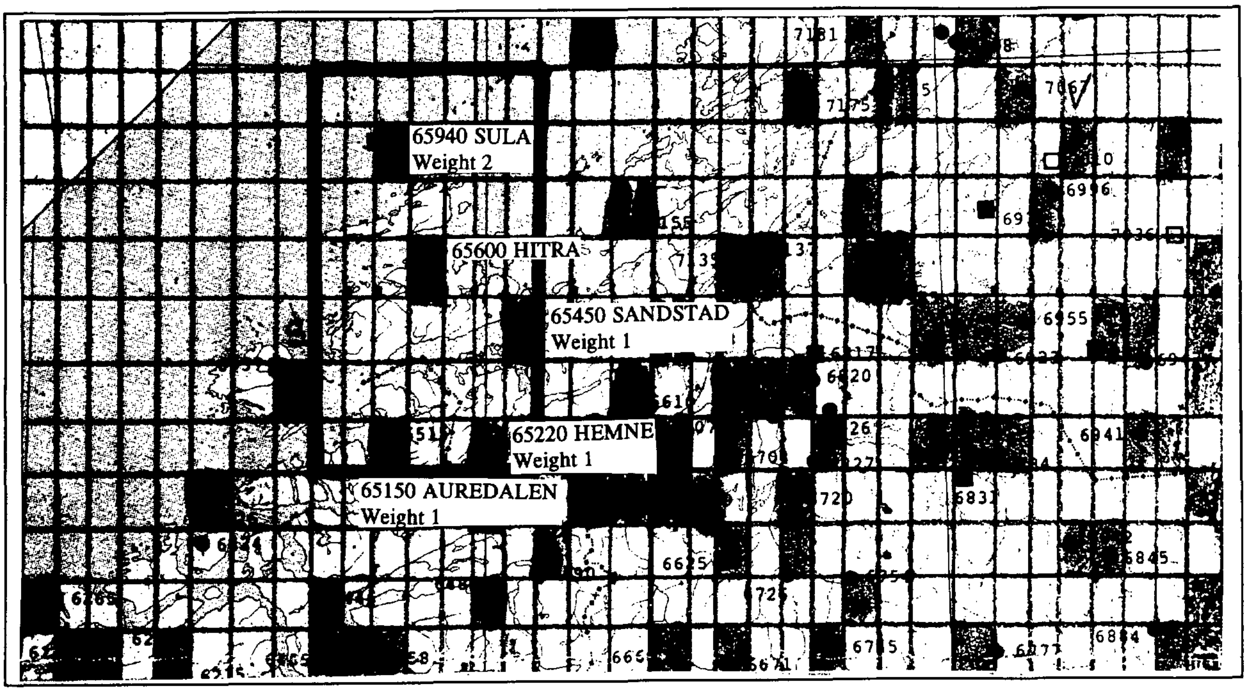


Figure 2.2.1.2 Illustration of grid, reference stations and weights.

For practical reasons (mainly plotting reasons) the dimensions of the grid covering Norway has been chosen to 96 times 110. The mesh size is approximately 10 times 7 square kilometres, and there are about 7400 cells. Each cell can only contain one station. The density varies somewhat corresponding to the population density, confer appendix 1 for a visual presentation of the grid.

As a consequence of algorithm 2.2.1.1 each test station is given between 0 and 48 reference stations with weights ranging from 1 to 3. The higher the weight the more likely is the station to be situated close to the test station and the more likely is the stations to be highly correlated. For a more detailed description of algorithm 2.2.1.1, see [8].

When reference stations and weights are chosen, an estimator can be constructed. Algorithm 2.2.1.3 gives the procedure for constructing estimators.

Algorithm 2.2.1.3

Construct an estimator of X as

$$\hat{X} = \frac{1}{r+2m+3n}\sum_{i=1}^{r} Y_i + \frac{2}{r+2m+3n}\sum_{i=1}^{m} Y_{i+r} + \frac{3}{r+2m+3n}\sum_{i=1}^{n} Y_{i+r+m} \qquad (2.2.1.4)$$

where $Y_1, Y_2, \ldots, Y_r$ are predictors with weight 1, $Y_{r+1}, Y_{r+2}, \ldots, Y_{r+m}$ are predictors with weight 2 and $Y_{r+m+1}, Y_{r+m+2}, \ldots, Y_{r+m+n}$ are predictors with weight 3.

It should be noticed that the estimator (2.2.1.4) is a convex combination of its predictors, i.e. $\sum_i a_i \equiv 1$ where a_i corresponds to the coefficient of Y_i. The expectation of $\hat{X}$ will consequently be a convex combination of the expectation of each $Y_1, Y_2, \ldots, Y_{r+m+n}$.

It should also be noticed that (2.2.1.4) is a special case of the more general formula

$$\hat{X} = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N_i} w_i Y_j^i}{\sum_{i=1}^{M} w_i M_i} \qquad (2.2.1.5)$$

for M distinct real weights w_i with M_i associated random variables $\{Y_j^i\}_{j=1}^{M_i}$ chosen in such a manner that $\sum w_i M_i \neq 0$.

Example 2.2.1.4.a

Choosing reference stations with observed amount of precipitation (*RR*) for the sixth of January 1993 for test station 4050 ENEBAKK resulted in the following list:

STNR	WEIGHT	RR	STNR	NAME
4050	3	45	3780	IGSI I HOBØL
4050	3	21	3930	TRØGSTAD
4050	3	50	4070	FLATEBY
4050	2	70	17500	FLØTER
4050	2	54	3450	HAGA I EIDSBERG
4050	2	20	2540	HØLAND - FOSSER
4050	1	21	17740	DRØBAK - ULLERUD
4050	1	58	17250	MOSS
4050	1	57	17150	RYGGE
4050	1	25	3500	SVARVERUD I EIDSBERG
4050	1	36	4850	RÅNÅSFOSS
4050	1	55	4260	SKEDSMO - HELLERUD
4050	1	67	4440	HAKADAL - BLIKSRUDHAGAN

The estimator of X_{4050} can be computed as

$$\left.\begin{aligned} \hat{X} &= \tfrac{1}{22}(X_{4440} + X_{4260} + X_{4850} + X_{3500} + X_{17150} + X_{17250} + X_{17740}) \\ &+ \tfrac{2}{22}(X_{2540} + X_{3450} + X_{17500}) \\ &+ \tfrac{3}{22}(X_{4070} + X_{3930} + X_{3780}) \end{aligned}\right\} \qquad (2.2.1.6)$$

and gives an estimate of 43 tenths of a millimetre (4.3 millimetre).

Example 2.2.1.4.b

Below is a table of computed *E(RR)* and observed *RR* values for precipitation station 4050 ENEBAKK the first 27 days of January 1993 (confer ex. 2.2.1.4.a).

STNR	MONTH	DAY	E(RR)	RR	DIFF	DIFF(%)
4050	1	1	-1	1	-2	-200%
4050	1	2	-1	-1	0	0%
4050	1	3	-1	-1	0	0%
4050	1	4	-1	-1	0	0%
4050	1	5	-1	-1	0	0%
4050	1	6	43	32	11	34%
4050	1	7	-1	-1	0	0%
4050	1	8	36	45	-9	-20%
4050	1	9	4	5	-1	-20%
4050	1	10	38	46	-8	-17%
4050	1	11	95	85	10	11%
4050	1	12	7	16	-9	-56%
4050	1	13	-1	-1	0	0%
4050	1	14	92	110	-18	-16%
4050	1	15	-1	-1	0	0%
4050	1	16	120	104	16	15%
4050	1	17	-1	-1	0	0%
4050	1	18	2	1	1	100%
4050	1	19	-1	-1	0	0%
4050	1	20	13	7	6	85%
4050	1	21	25	16	9	56%
4050	1	22	14	24	-10	-41%
4050	1	23	-1	-1	0	0%
4050	1	24	88	61	27	44%
4050	1	25	27	26	1	3%
4050	1	26	-1	1	-2	-200%
4050	1	27	-1	-1	0	0%

For all days with no precipitation (RR = -1) the estimat is -1. For other observed values the estimate is sometimes a couple of millimetres above the observation and sometimes a couple of millimetres below the observation.

For small amounts of observed precipitation there seems to be a more accurate estimate than in the case of larger amounts of observed precipitation, allthough the relative difference may be quite large for very small amounts.

2.2.2 Discriminating between dry weather and precipitation of zero intensity

When observing precipitation one discriminates between an unmeasurable size of precipitation (less than 0.05 mm), which is reported as 0 mm, and no precipitation at all, which is by convention given the value of -1 when digitalized, confer definition 2.1.1.

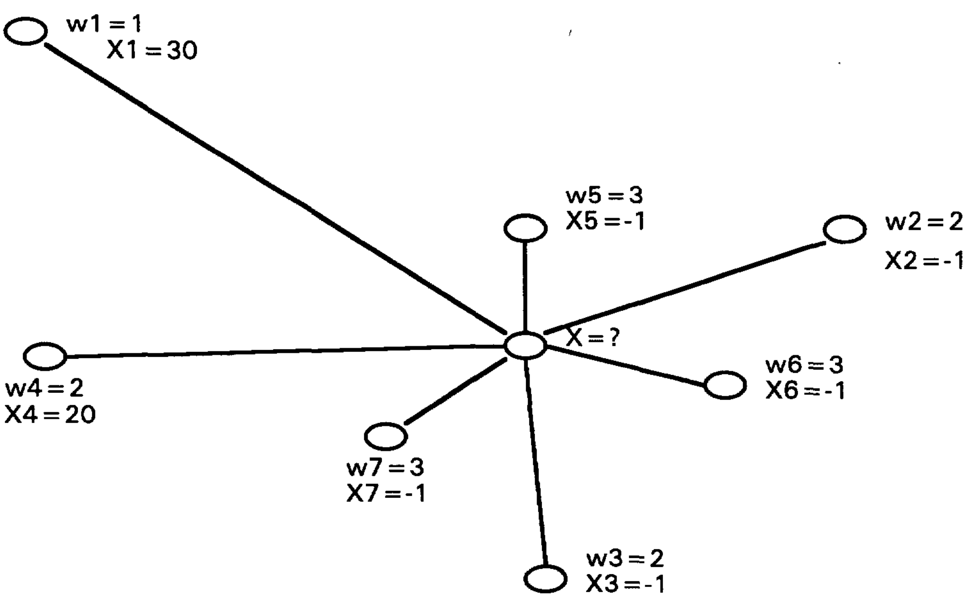
The purpose of this paragraph is to make sure that using the value of -1 will work consistently with other values of precipitation when producing estimates.

If one should codify the state of *no precipitation* and use this code consistently with regular numbers, one must choose one of the numbers -1,-2,-3,... as a code value. The value of -1 is the greatest integer less than zero, and is as such the number closest to zero having no interpretation as a measure of precipitation when using the traditional metrification on the set of integers as a subset of the real numbers.

Example 2.2.2.1 illustrates how the code value -1 interacts in the estimating process for some samples of reference precipitation.

Example 2.2.2.1

The figure shows a molecule of reference stations with prescribed weights $w_1, w_2, \ldots, w_7$ and observed values of precipitation as outcome from the random variables $X_1, X_2, \ldots, X_7$. One would like to estimate the outcome of a random variable X modelling the daily amount of precipitation at the test station in the centre of the molecule.



The estimator $\hat{X}$ is computed according to (2.2.1.1) as follows

$$\hat{X} = \tfrac{1}{1+6+9}(30) + \tfrac{2}{1+6+9}(20-1-1) + \tfrac{3}{1+6+9}(-1-1-1) = \tfrac{57}{16} \approx 4$$

meaning no precipitation except for two distant stations generates an estimate of 4 (0.4 mm).

A local shower at some distance may, as observed, influence the estimate if its precipitation is significant.

To avoid such situations there are two possibilities:

1) use a smaller integer to represent dry weather, ie. -2, -10, ...

2) multiply the weights with a real number greater than one and thereby make a sharper discrimination.

3) use median value instead of mean value.

The first possibility is probably not worthwhile because when comparing stations with equal weight where one of the stations has a outcome of dry weather (-*K* for some non-negative integer *K*) the other station would have to have precipitation greater than the value *K* (*K*/10 mm) in order to get a non-negative estimate.

Regarding possiblilty no. 2: References close to the station are likely to be better correlated than references far apart. Experimenting with different gradients for the weights could be an interesting way of improving the system. In this report, however, an other approach has been tried out, using the correlation more directly, as will be explained in section 3.

Using median values as i possiblility no. 3 may be a good idea. For programming reasons however (using SQL-code only) the computation of median values is not directly feasible. Also from a mathematical point of view the arithmetic mean has an advantage, cf. central limit theorem [10, p. 210f].

2.2.3 Handling missing values and erroneous data

If one or more of the reference stations cannot support data for computing an estimate or the data provided is obviously wrong, the predictors corresponding to these stations should be temporarily removed from formula (2.2.1.4). This does also imply the recomputation of the denominators of the coefficients in (2.2.1.4).

When using the estimation technique in quality control the data being used to generate estimates have not yet been completly controlled. It would be interesting to know in what way erroneous data can influence the process of estimation.

When differentiating (2.2.1.4) by parts the following equation of differentials can be constructed:

$$\delta\hat{X} = \frac{1}{r+2m+3n}\sum_{i=1}^{r}\delta Y_i + \frac{2}{r+2m+3n}\sum_{i=1}^{m}\delta Y_{i+r} + \frac{3}{r+2m+3n}\sum_{i=1}^{n}\delta Y_{i+r+m} \qquad (2.2.3.1)$$

From (2.2.3.1) it is seen that one unit of error in one of the predictors will induce a, $2a$ or $3a$ units of error in $\hat{X}$ where $a = \frac{1}{r+2m+3n}$.

There are 652 items in the reference station table. The table 2.2.3.1 shows the number of stations observering on a daily basis and the number of stations that have references in the present reference station table.

Population	Number of stations observing on a daily basis	Number of stations with reference stations
1992	766	649 (85%)
1993	761	652 (86%)

Table 2.2.3.1 Number of precipitation stations 1992-1993.

Regarding the population of 1992, there are 8.4 reference stations for each test station on the average, with a standard deviation of 4.9 stations. All test stations have at least one and at most 39 reference stations.

As the density of stations are not uniformly distributed across Norway, algorithm 2.2.1.1 will assign different number of reference stations to each station for different parts of the country. The table 2.2.3.1 shows statistics for each county ordered by the average number of references per station.

COUNTY	AVG	STDDEV	MAX	MIN
OSLO	24.4	1.7	26	22
AKERSHUS	17.8	5.1	25	8
VESTFOLD	12.5	2.5	16	7
ØSTFOLD	12.0	5.0	20	3
BUSKERUD	10.8	6.2	39	3
TELEMARK	10.4	2.7	15	4
HORDALAND	10.3	3.3	15	3
ROGALAND	10.3	3.2	16	3
SOGN-OG FJORDANE	9.8	3.0	15	2
AUST-AGDER	9.8	3.0	15	5
OPPLAND	8.7	3.0	20	4
VEST-AGDER	8.3	2.5	13	3
SØR-TRØNDELAG	8.2	3.8	15	1
MØRE-OG ROMSDAL	7.7	2.5	13	2
NORD-TRØNDELAG	5.6	2.5	10	1
HEDMARK	5.4	2.4	11	2
NORDLAND	4.0	1.7	8	1
TROMS	3.4	1.3	6	1
FINNMARK	2.1	1.0	4	1

Table 2.2.3.1 Number of references per stations grouped by county and order by average number of references per station.

The average of reference stations with a weight of 3 is 1.9 with a standard deviation of 1.2. All stations have at least one and at most nine reference stations with a weight of 3. The average number of stations with a weight of 2 is 3.1, and average number of stations with a weight of 1 is 4.5. The standard deviation of these two last categories is somewhat greater than the first, $std_2=2.3$ and $std_3=2.6$.

By accommodating the averages in order to fit into the denominator of a ($r=2$, $m=3$, $n=4$ and total average = 9), the expected consequence of one unit of error in a predictor of weight 3 is 0.2 units of error in the estimator.

There are 19 stations with exactly one reference station, 36 stations with two reference stations and 42 stations with three reference stations. For a station with one reference station a unit error in the predictor will cause a unit error in the estimator.

On the whole the process of estimating according to (2.2.1.4) is fairly stable, and errors of a tolerable size in the predictors should theoretically only introduce minor errors in the estimate.

2.3 Numerical experiments

The purpose of this section is to evaluate the estimator $\hat{X}$, as defined by algorithm 2.2.1.3, by statistical means. If some of the estimators are heavily biased or have large standard errors, special knowledge outside of the quality system must be used in order not to correct data that are very likely to be correct. In order to prevent this there is an analysis on some of the statistically worst estimators.

2.3.1 Statistical evaluation of the estimation

By defining $\theta_i = \hat{X}_i - X_i$, the bias of an estimator can be estimated through the formula

$$\mathrm{BIAS}(\hat{X}) \approx \bar{\theta} = \tfrac{1}{n}\sum_{i=1}^{n}\theta_i \qquad (2.3.1.1)$$

where X_i and $\hat{X}_i$ are samples of the random variables X and $\hat{X}$ from a sample of size n.

The sample values can also be used to estimate standard error and maximum absolute error using the formulas

$$\mathrm{S.E.}(\hat{X}) \approx \sqrt{\sum_{i=1}^{n}\frac{(\bar{\theta}-\theta_i)^2}{n-1}} \qquad (2.3.1.2)$$

and

$$\mathrm{M.A.E.}(\hat{X}) \approx \max_{i\in\{1,2,\ldots,n\}}|\theta_i| \qquad (2.3.1.3)$$

provided the sample size n is large enough.

Table 2.3.1.1 shows some statistics using the sample of all 649 stations of 1992, n=365.

avg bias	max bias	avg S.E.	max S.E.	avg M.A.E.	max M.A.E.
-0.2	47.9	28.9	95.7	222.8	1126

Table 2.3.1.1 Estimation statistics

In appendix 2 there is a complete list of stations with estimated bias, standard error and maximum absolute error.

2.3.2 Worst case analysis: BIAS

Table 2.3.2.1 below lists the ten most biased stations. The most biased station, 59800 SVINØY FYR, does not have the estimator with the greatest errors. The station 57780 GRØNDALEN is biased in the opposite direction and generates somewhat larger errors on the average.

STNR	NAVN	BIAS	S.E.	M.A.E.
59800	SVINØY FYR	47.9	90.3	825
57780	GRØNDALEN	-42.7	95.7	964
52930	BREKKE I SOGN	-40.6	73.7	448
80200	LURØY	-35.7	87.7	763
85540	LEKNES I LOFOTEN	34.9	84.1	753
85660	REINE	-34.9	84.1	753
52600	HAUKELAND	-31.4	72.5	504
48160	BØRTVEIT PÅ STORD	-31.3	71.5	479
52530	HELLISØY FYR	30.1	48.9	446
58070	SANDANE	29.3	54.3	557

Table 2.3.2.1 A ranking list of the ten most biased estimators

59800 SVINØY FYR is a lighthouse on the coast of Herøy in Møre and Romsdal. The reference stations 59450 STADLANDET (weight two), 59610 FISKÅBYGD (weight two) and 59560 BRANDAL (weight one) are placed on the cost land and at least 20 km away from the lighthouse.

The heaviest precipitation in Norway occurs in a zone behind the coast of western Norway. This is due to the frequent occurrence of low-pressure systems with humid air moving in from the sea. They are pushed up by the mountains and give off "orographic" precipitation, confer [16] for a visual presentation. Using reference stations from this area causes a systematic overestimation of a test station in a coastal area.

The relative low correlation with predictors from reference stations is probably a cause to the large standard error. The height (metres) above sealevel (*HOH*) does not vary radically between the stations, but the precipitation normals 1961-1990 (*PN*) in a unit of millimetres copied from [17] do vary. Using the estimation formula on the normal values gives an estimate of 2162 mm.

STNR	STATION	HOH	PN
59800	SVINØY FYR	38	780

STNR	STATION	HOH	WEIGHT	CORR	PN
59450	STADLANDET	75	2	0.70	2183
59610	FISKÅBYGD	41	2	0.50	2010
59560	BRANDAL	17	1	0.48	2425

The next station, 57780 GRØNDALEN, is situated in the community of Flora in Møre and Romsdal. In this case the situation is opposite of SVINØY FYR as GRØNDALEN is situated at a peak in the precipitation surface and is systematically being underestimated by its reference stations. This underestimation may cause the high standard- and maximum absolute error.

STNR	STATION	HOH	PN
57780	GRØNDALEN	105	3520

STNR	STATION	HOH	WEIGHT	CORR	PN
56650	DALE I SUNNFJORD II	51	1	0.91	2730
57680	EIKEFJORD	30	3	0.90	2597
57660	EIMHJELLEN	170	2	0.88	2760
57990	GJENGEDAL	230	1	0.88	2425
57850	DAVIKNES	178	3	0.86	2310
57810	SVELGEN II	3	3	0.84	2560
57610	GRYTA	34	2	0.82	2885
57110	OSLAND VED STONGFJORDEN	162	1	0.79	2395
59200	ULVESUND	1	2	0.78	3052
57940	ÅLFOTEN II	24	2	0.76	2204

The station 85060 LEKNES I LOFOTEN can be found in the community of Vestvågøy on the Lofoten Islands in Nordland. The situation is similar to GRØNDALEN, except that in this case there is only one reference station, REINE on southern part of Moskenes, and the correlation between the two stations is not especially good.

STNR	STATION	HOH	PN
85540	LEKNES I LOFOTEN	13	1224

STNR	STATION	HOH	WEIGHT	CORR	PN
85660	REINE	17	1	0.71	2285

3. IMPROVED WEIGHTED LINEAR ESTIMATION

As observed in section 2.3 some estimators have a systematic tendency of overestimating the precipitation of the test station as in the case of SVINØY FYR, while other systematically underestimates like in the case of GRØNDALEN.

In the study of such cases it was also noticeable that the weights given to certain predictors were not always in correspondance with the correlation of the stations, i.e. some predictors with precipitation profiles quite different from the one of the test station were given a greater weight than predictors whose profile were more alike.

The objective of this section is firstly to remove the bias from the estimates, and secondly to generate a new set of reference stations with weights for each test station. The weights will be derived from the correlation between the stations.

3.1 Correctional factor

The bias of $\hat{X}$ in the previous section varied from -42.7 to 47.9. The first attempt of improving the estimator will consist of constructing a correctional factor C for each station and redesign the estimator $\hat{X}$ in the form of

$$\hat{X} = C\sum w_i Y_i \qquad (3.1.1)$$

where each w_i is constructed as before by algorithm 2.2.1.3.

If one chooses

$$C = \frac{E(X)}{E(\hat{X})} \qquad (3.1.2)$$

the bias of $\hat{X}$ can be computed as

$$\begin{aligned} E(C\hat{X} - X) &= E(\frac{E(X)}{E(\hat{X})}\hat{X} - X) \\ &= \frac{E(X)}{E(\hat{X})}E(\hat{X}) - E(X) \\ &= 0 \end{aligned}$$

In other words, if it is possible to choose a number C estimating the fraction $E(X) / E(\hat{X})$, the bias of $\hat{X}$ is likely to be small.

Table 3.1.1 below makes a comparison of average bias, maximum absolute bias, average standard error, maximum standard error, average maximum absolute error and maximum maximum absolute error over the population of 649 precipitation stations, using as before the set of quality controlled precipitation data from 1992. The correctional factors are computed according to (3.1.2) also using the same set of data from 1992.

The relative improvement, $\frac{X_{\text{simple}} - X_{\text{correctional factor}}}{X_{\text{simple}}} 100\%$, is shown in parentheses.

Method	avg bias	max bias	avg S.E.	max S.E.	avg M.A.E.	max M.A.E.
simple	-0.2 (0%)	47.9 (0%)	28.9 (0%)	95.7 (0%)	222.8 (0%)	1126 (0%)
corr. fact.	0.0 (100%)	0.0 (100%)	26.4 (9%)	87.2 (9%)	196.0 (12%)	902 (20%)

Table 3.1.1 Statistical comparison of the grid method and the grid method with correctional factor.

Table 3.1.2 and 3.1.3 show rankings of the ten stations with the most standard error and maximum absolute error respectively.

STNR	NAVN	BIAS	S.E.	M.A.E.
85660	REINE	0.0	87.2	711
57780	GRØNDALEN	0.0	78.3	568
57110	OSLAND VED STONGFJORDEN	0.0	77.3	473
46510	MIDTLÆGER	0.0	77.0	519
49070	KVÅLE	0.0	72.6	607
64700	INNERDAL	0.0	71.5	902
45350	LYSEBOTN	0.0	70.4	720
47890	OPSTVEIT	0.0	67.7	633
73620	HARRAN	0.0	66.5	518
80200	LURØY	0.0	63.7	543

Table 3.1.2 Ranking of the ten stations with the most standard error computed with correctional factor.

STNR	NAVN	BIAS	S.E.	M.A.E.
64700	INNERDAL	0.0	71.5	902
45350	LYSEBOTN	0.0	70.4	720
85660	REINE	0.0	87.2	711
51670	REIMEGREND	0.0	44.8	650
47890	OPSTVEIT	0.0	67.7	633
49350	TYSSEDAL I	0.0	62.7	625
49070	KVÅLE	0.0	72.6	607
57780	GRØNDALEN	0.0	78.3	568
59610	FISKÅBYGD	0.0	47.7	551
50120	SKULAFOSSEN KRAFTSTASJON	0.0	56.5	544

Table 3.1.3 Ranking of the ten stations with the most maximum absolute error computed with correctional factor.

SVINØY FYR which topped the list in table 2.3.2.1 is not present in the tables 3.1.2 and 3.1.3. The station has now no bias, an average standard error of 33.9 (an improvement of 62%) and a maximum absolute error of 265 (an improvement of 68%).

The stations 85660 REINE, 57780 GRØNDALEN and 80200 LURØY are however still present. The relative improvement in the statistics are:

STNR	NAVN	BIAS	S.E.	M.A.E.
57780	GRØNDALEN	100%	18%	41%
80200	LURØY	100%	27%	28%
85660	REINE	100%	-4%	6%

This reflects that there is a general improvement by introducing a correctional factor, about 10% on the average, although the error may increase in some special cases as with 85660 REINE.

In order to give a 100% improvement in the bias as in table 3.1.1 both the correctional factor and the estimats must be generated over the same population of precipitation data.

For practical purposes it would be convenient if one could generate correctional factors that were independent on time, i.e. factors that could be stored in database tables just like the weights. A systematic study of how to get values representative for each set of reference stations has, however, been outside the scope of this project. Some shallow investigations have on the other hand indicated that the correctional values may vary somewhat from year to year. Using precipipitation normals as local estimats in (3.1.1) and (3.1.2) could therefore be a reasonable guess for generating a more stable factor.

3.2 Improved criterion for choosing reference stations

Although some of the stations in table 3.1.2 corresponded with stations analysed in section 2.3, their respective standard error and maximum absolute error were somewhat less. The objective of this section is to improve further on reducing the errors.

As observed in section 2.3, there is no functional correspondance between the weights of the predictors and correlation between test- and reference stations. Algorithm 3.2.1 below suggests a method for constructing reference stations with weights reflecting the reference stations correlation with the test station. Estimation will then be done using formula (2.2.1.5) with a correctional factor.

Algorithm 3.2.1

For each test station X

1) Make a neighbourhood with centre in the test station that is likely to contain most of the reference stations of interest.

2) For each reference station Y_i in the neighbourhood, compute its correlation

$$c_i = \text{corr}(X, Y_i)100\% \qquad (3.2.1)$$

   with the test station.

3) Drop predictors Y_i from the list of reference stations to X if they are likely to distort the estimator.

4) Compute weights w_i as a monotone increasing function of c_i (f. ex. $w_i = c_i^2$).

In the algorithm 3.2.1 there are three parameters that may be adjusted; the limit that decides the ratio of the neighbourhood associated with each station, the choice of stations from the neighbourhood that are good enough to be used as reference stations, and the design of the function that gives a weight to each reference station given its correlation with the test station.

As the density of stations is highly irregular in Norway, ratios have been chosen as 0.7 degrees latitude and 1.0 degrees longitude for stations in the southern part (stnr 1 to 69999), 1.5 degrees latitude and 2.0 degrees longitude for the northern part (stnr 70000 to 99699) and 5 degrees latitude and 17 degrees longitude for other stations (stnr 99700 to 99999, the Arctic area). By choosing these geographical parameters one is guaranteed a minimum of 4 references per station. The average number of references is 39. The choice of working with geographical coordinates instead of metric distances is due to storage and computing reasons.

By numerical experiments it looks like estimates from stations with correlation below 50% are of little use. When using only references with correlation larger than some increasing limit, the estimates tend to get increasingly better. On the other hand, the number of reference stations assigned to each test station decreases, and the less reference station a stations has, the more vulnerable it is when one or more of the references have missing data

Too many references per station does however seem to enlarge the variance in estimation. By trial and error it seems as if choosing the ten predictors with the highest correlation is a reasonable choice.

When designing a function that assigns a weight to each correlation value, it was important that the function grew rapidly enough and that it had no vertical asymptote. By experimenting with polynomial transformations of c_i, generating weights, the function

$$w_i = \lceil c_i^{12} 100^{-10} - 0.5 \rceil \qquad (3.2.2)$$

where $\lceil x \rceil$ indicates the least integer greater or equal to x, proved quite well. A correlation of 50% is given a weight of 2 while a correlation of 100% is given a weight of 10000. Predictors with correlation below 50% are given a weight of zero and not used constructing the estimators.

The algorithm 3.2.1 tries to make up for the non-uniform density of stations, as explained under point 1). The table 3.2.2 shows statistics for each county ordered by the average number of reference stations per test station.

COUNTY	AVG	STDDEV	MAX	MIN
AKERSHUS	10.0	0.0	10	10
AUST-AGDER	10.0	0.0	10	10
NORD-TRØNDELAG	10.0	0.0	10	10
OSLO	10.0	0.0	10	10
SOGN-OG FJORDANE	10.0	0.0	10	10
VEST-AGDER	10.0	0.0	10	10
ØSTFOLD	10.0	0.0	10	10
VESTFOLD	10.0	0.0	10	10
TROMS	10.0	0.0	10	10
ROGALAND	10.0	0.0	10	10
SØR-TRØNDELAG	10.0	0.1	10	9
HEDMARK	9.9	0.7	10	5
OPPLAND	9.8	1.3	10	1
BUSKERUD	9.7	1.6	10	1
FINNMARK	9.7	1.3	10	3
MØRE-OG ROMSDAL	9.6	1.5	10	3
TELEMARK	9.6	1.7	10	1
HORDALAND	9.6	1.9	10	1
NORDLAND	9.2	2.4	10	1
ARKTISK	1.0	0.0	1	1

Table 3.2.2 Number of references for each station grouped by county and ordered by average number of references.

I table 3.2.2 only the ten most highly correlated reference stations were used in situations when the test station had more than ten reference stations. The total average of references per station is 9.8 with a standard deviation of 1.3, a maximum of 10 and a minimum of 1. There were 8 stations without reference stations, i.e. none of these were sufficiently correlated to any of the other stations.

Table 3.2.3 shows the statistics from applying the new set of reference stations and weights according to the procedure of weighted linear estimation with a correctional factor.

Table 3.2.3 shows the statistics from applying the new set of reference stations and weights as compared with the method of weighted linear estimation using a grid. In both cases correctional factors have been computed. Only test stations having references in both systems have been used.

Method	avg. bias	max. bias	avg. S.E.	max S.E.	avg M.A.E.	max M.A.E.
grid weigths	0.0 (0%)	0.0 (0%)	26.4 (0%)	87.2 (0%)	196.0 (0%)	902 (0%)
corr weights	0.0 (0%)	0.0 (0%)	23.5 (11%)	78.6(10%)	163.1 (17%)	711 (21%)

Table 3.2.3 Statistical comparison of the simple method and the improved method with correctional factor.

4. APPLICATIONS TO QUALITY CONTROL

The objective of quality control is to find data that are very likely to be incorrect and mark these values so that they may be replaced with more likely values. As it would be a more serious error replacing data that are correct with estimates, than not replacing erroneous observations, the following hypothesises are put forward:

H_0: The piece of data being investigated is correct

H_1: The piece of data being investigated is incorrect

The objective of a quality control routine is to gather sufficient evidence in order to reject the H_0-hypothesis. If it is not evident that H_0 is incorrect, the piece of data will not be manipulated.

In order to have an idea of when to reject H_0, there is a need to know more about the relationship between the amount of precipitation and the error in estimation. Is it for example reasonable to believe that areas with a high frequency of heavy precipitation is likely to have large errors in their estimates?

The relationship will be used to construct a function deciding when to reject the H_0-hypothesis. If the hypothesis is rejected the suspicious value is marked. The last subsection discusses some possibilities for choosing values for replacement.

4.1 Relationship between amount of precipitation and error in estimation

Figure 4.1.1 shows the estimation errors associated with a station 19200 using the precipitation of 1992 as a population.

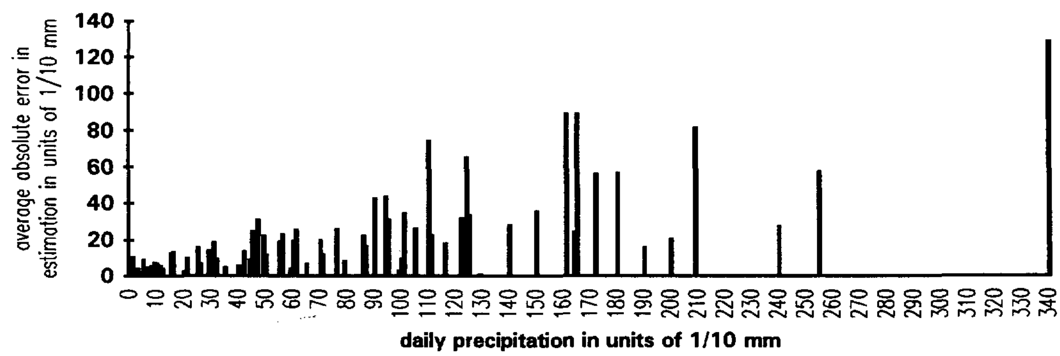


Figure 4.1.1 Errors of estimation distributed with respect to the amount of precipitation

The data being scattered makes it difficult to make statistical deductions. There is however reason to believe that the error increases with the amount of precipitation. It would be interesting to know if one could be more specific, i.e. is the error increasing at a constant rate, is the error increasing more rapidly as the precipitation increases or does it increase more slowly.

Table 4.1.2 shows results from estimating the correlation between the observations X and the absolute difference $T = |\hat{X} - X|$.

Transformation	avg corr(X,Y)	stddev corr(X,Y)	max corr(X,Y)	min corr(X,Y)
$Y=\sqrt{T}$	54%	12%	86%	2%
$Y=T$	66%	8%	87%	14%
$Y=T^2$	54%	11%	84%	2%

Table 4.1.2 Estimation of the relationship between observation and error

As the table does not indicate that the correlation will be improved by some sublinear or superlinear function we shall adopt the belief that the relationship is linear.

Assuming the linear relationship, one can construct linear regression models

$$|\hat{X} - X| = \alpha + \beta X + \omega \qquad (4.1.1)$$

for all stations where ω represents the noise (the residual) associated with the predictor X. The results from solving the normal equations is summed by the statistics in table 4.1.3.

Coefficients	Average	Std. deviation	Max	Min
alpha	5.1	3.9	62.9	-1.6
beta	0.2	0.1	1.0	0.03

Table 4.1.3 Estimation of coefficients in linear model (4.1.1)

4.2 Constructing a rejection function

If it was a perfect linear correlation between the observations and the absolute error, i.e. $\omega \equiv 0$ for all X in formula (4.1.1), the rejection area for the H_0-hypothesis above could be deterministically designed as in figure 4.2.1. The hypothesis is to be rejected if the point $(\hat{X}, X)$ happens to land outside of the cone in the positive quadrant.

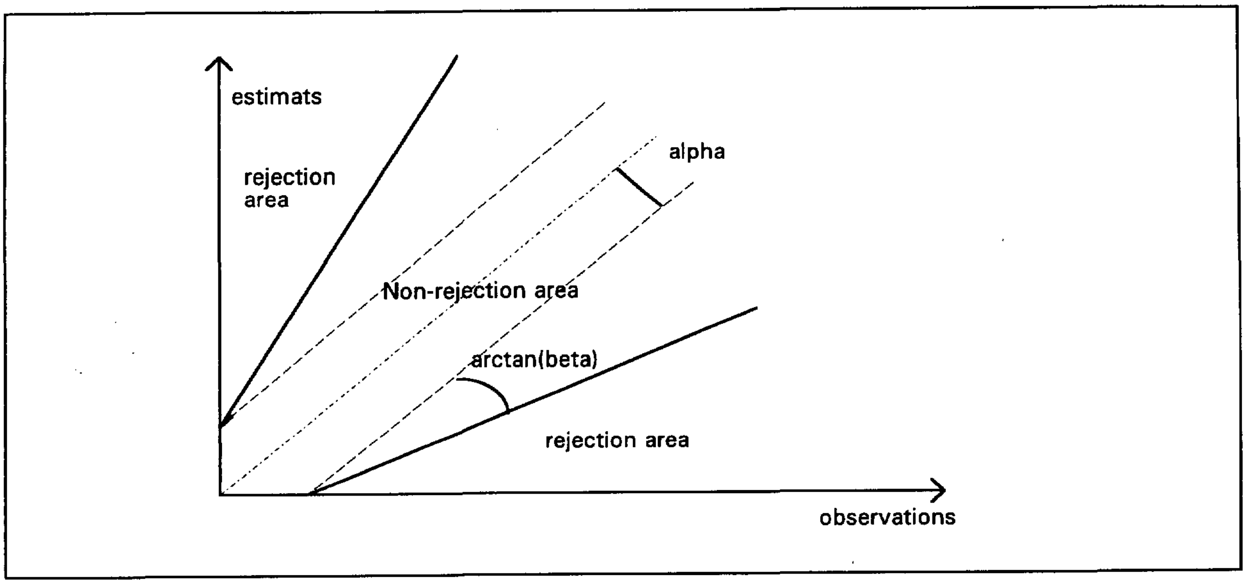


Figure 4.2.1 Rejection area

A problem arises for outcome that is close to the boundary of the cone, but considering the consequences associated with rejecting the H_0-hypothesis wrongly the mean residual sum estimate could be added to alpha making the probability of rejecting H_0 wrongly less.

In algorithm 4.2.1, useful for practical implementation of the test, some trigonometry have been used in order to simplify the test.

Algorithm 4.2.1

Let the random variable X denote the daily amount of precipitation at a given station. Let the random variable $\hat{X}$ denote an estimator with respect to X.

For each outcome of $(X, \hat{X})$ the H_0-hypothesis described above is *not* to be rejected if

$$\frac{\hat{X}}{\tan(\arctan(\beta) + \pi/4)} - \frac{\alpha}{\sqrt{2}} \leq X \leq \frac{\alpha}{\sqrt{2}} + \tan(\arctan(\beta) + \pi/4)\hat{X} \qquad (4.2.1)$$

where the alpha and beta are empirically decided.

Using the statistics from table 4.1.3, formula (4.2.1) evaluates to

$$0.7\hat{X} - 3.6 \leq X \leq 1.5\hat{X} + 3.6 \qquad (4.2.2)$$

the boundary of the cone makes an angle of 11 degrees with its diagonal.

In the KVALM/KVALU system, the formula

$$k^{-1}\hat{X} \leq X \leq k\hat{X} \qquad (4.2.3)$$

with k equal 3 was used in the earlier versions. This implied an angle between the boundary of the cone and its diagonal of about 18 degrees. An enormous outpour of suspect values for small X made it necessary to improve the criterion. The improvement consisted of a less course test for values less than 5 mm.

4.3 Correcting data and interpolating missing values

If a piece of data is found suspicious it should be replaced. One obvious candidate for the corrected value would be the estimate, but on the other hand, looking at the errors associated with the techniques of estimation one could introduce an error of several centimetres in some extreme cases.

One should also investigate what may be the cause of some detected error in the precipitation series. Some frequently occuring types of errors are accumulation, wrong day of registration and incorrect time of observation.

5. SOME THOUGHTS CONCERNING FURTHER DEVELOPMENT

This section presents some techniques that have not yet been tried out to a full extent, but might be useful for a further propagation on the subject of estimation and quality control.

The section is divided into parts discussing pre-processing of data, regression methods, the use of more advanced techniques of linear estimation and median estimation techniques.

5.1 Pre-processing of the data

Section five of [15] is introduced with the following passage:

Frequently the details of an areal estimation scheme is more important that the selected estimation method itself. Analogously the treatment of the data in advance of the application of estimation on techniques generally is conclusive for the properties of the estimate obtains (...).

The following steps related to pre-processing of the raw data are important:

1. *Check of the data quality. Concerns all data relevant for the estimation.*

2. *Correction for errors inherent with gauge data. The systematic deficits, in particular due to errors connected with influence from wind, wetting and evaporation, should be corrected for.*

3. *Pre-processing (scaling/rectification/calibration etc.) of remotely sensed data (for multivariate estimation).*

4. *Normalization of the data by use of climatological information. This procedure is normally used to reduce the influence on the areal estimate from local effects, for instance, local orographic influences. The assumption of isotropy will then be more realistic.*

The correctional factor introduced in section 3.1 should compensate for the effects described in points 2, 3 and 4 to a certain extent, but the factor is only an adjustment of the total estimate and not an adjustment of the raw data. Constructing an estimator

$$\hat{X} = C\sum_{i=1}^{n} w_i \xi_i (Y_i) \qquad (5.1.1)$$

where each piece of data is transformed due to some empirical function for each pair of stations, is more complicated than the techniques used so far.

When using the methods described in this report, however, point one seems to make the most serious threat towards the quality of the estimates. Using the weighted linear estimates the errors induced is a fraction of the introduced error, but it should be useful to do some simple controls on each of the separate stations, f. ex. a dip test and a leap test (confer [6]), before generating weighted linear estimates.

The effect of normalizing the data should however be investigated systematically.

5.2 Regression methods

In [15] there is a discussion on regression methods and polynomial approximation. Multilinear regression models have also been widely used from estimation and interpolation purposes at DNMI. Quality control of air pressure has been thoroughly investigated with good results [4].

Prior to this report an attempt to solve the problem of distributing accumulated precipitation with straight forward multilinear regression was tried out. An implementation of the method of least squares did however not prove satisfactory, and the weighted linear estimator ideas were investigated instead.

The cause of the problems with traditional multilinear regression models is the premise of the predictors being independent. This can be stretched to some extent, but when the predictors are heavily correlated, the so called *normal equations* become badly conditioned. If the outcome of two or more predictors were linearly dependent, the system would be singular and impossible to solve, confer Golub & van Loan [18] for a theoretical discussion on least squares problems.

5.3 The general theory of linear estimation

In this report some of the concepts of linear estimation have been used. The general theory of linear estimation, as presented by f. ex. [13], does however provide us with theory and examples that could be used for generating more dynamic types of estimators.

For pursuing the regression methods further, an ortogonalization of the predictors might be a good choice ([13], proposition 1.1.2).

Using information on the seasonal behaviour of precipitation a stochastic dynamic model might be constructed and Kalman filters could be applied.

5.4 Median estimation methods

Due to the effect of local showers using the median value of precipitation may prove better than the arithmetic mean. The Danish and Swedish meteorological institutes use techniques based on medians and percentiles instead of weighted linear estimation, confer [19]. The pros and cons of these concurrent methods should be evaluated.

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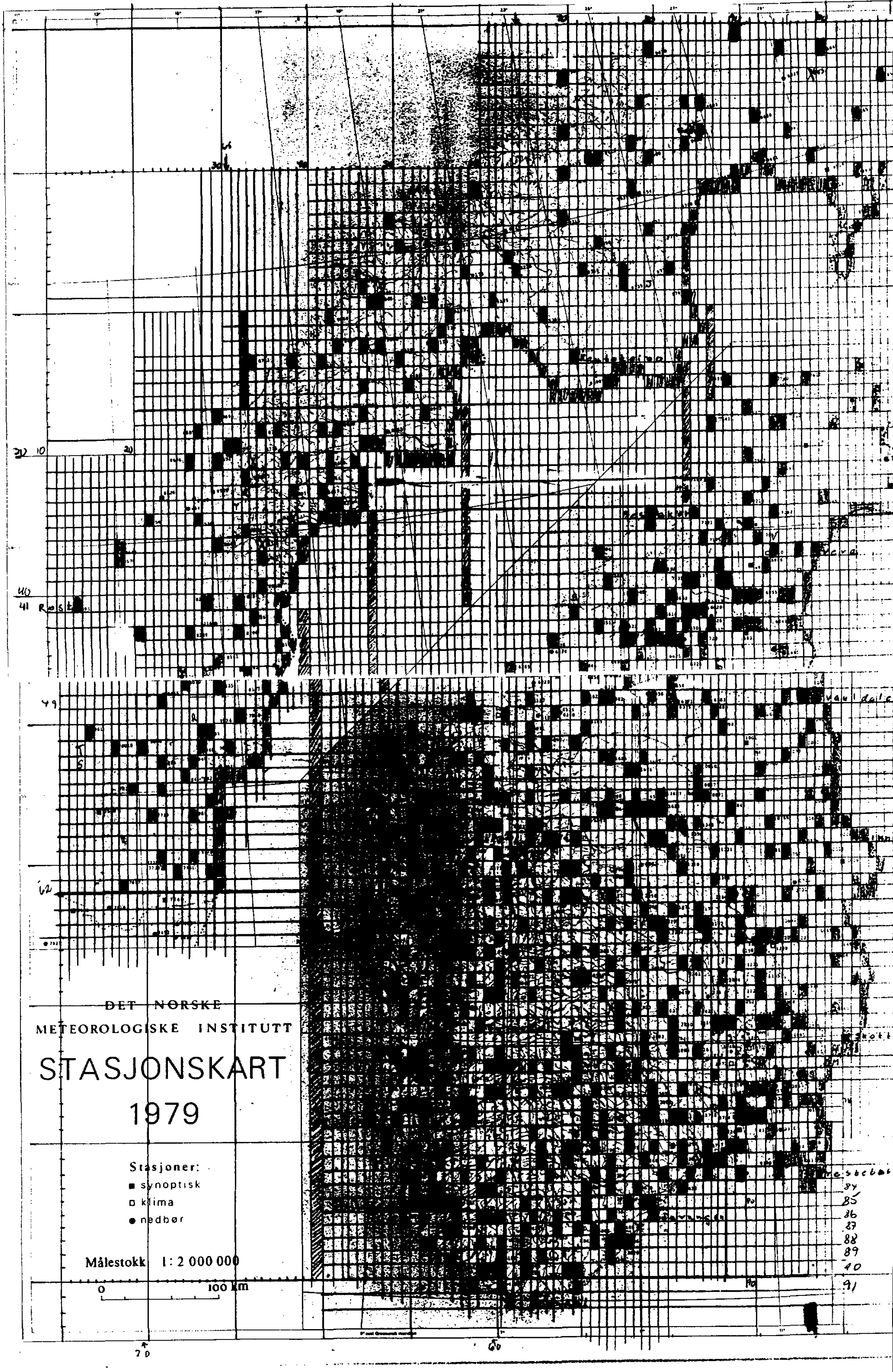
APPENDIX 1

Grid map for estimation purposes. Each filled cell contains one and only one station. Confer section 2 for further explanations.



APPENDIX 2

Estimative power of original method (grid weight method).

The table below shows bias, standard error and maximal absolute error in a unit of one tenth of a millimeter of precipitation when evaluating the estimator in section 2. Quality controlled data from the period 1. January - 31. December 1992 (365 observations for each station) is used in order to generate statistics.

Stations without statistics have no reference stations.

STNR	NAVN	BIAS	S.E.	M.A.E.
60	LINNES	-3.7	19.1	136
100	PLASSEN	-1.5	25.5	213
290	TÅGMYRA	0.7	17.3	106
420	HEGGERISET - NORDSTRAND	-0.2	16.5	131
600	GLØTVOLA	2.2	13.8	106
700	DREVSJØ	2.8	13.5	87
730	VALDALEN	-4.2	22.0	272
770	ELLEFSPLASS	-0.3	16.7	142
810	TUFSINGDAL - MIDTDAL	1.5	17.3	108
900	LANGEN	-1.9	25.4	152
1080	HVALER	2.5	16.9	98
1130	PRESTEBAKKE	-1.7	20.4	138
1230	HALDEN	0.1	15.7	84
1400	BREKKE SLUSE	-1.6	15.6	148
1650	STRØMSFOSS SLUSE	1.3	12.6	61
1950	ØRJE	-1.1	13.3	147
2170	SETTEN	1.1	14.5	97
2540	HØLAND - FOSSER	2.2	14.0	72
2610	BJØRKELANGEN II	-2.3	17.6	154
2910	SKOTTERUD - BERGSTAD	-1.1	13.2	116
2950	MAGNOR	1.1	23.8	365
3150	KALNES	-2.9	18.6	162
3190	SARPSBORG	-1.6	16.5	97
3200	BATERØD			
3280	RAKKESTAD - SANDER			
3450	HAGA I EIDSBERG	0.7	10.7	80
3500	SVARVERUD I EIDSBERG	-1.7	16.6	178
3780	IGSI I HOBØL	0.7	13.4	114
3930	TRØGSTAD	1.5	13.7	115
4050	ENEBAKK	1.4	17.2	208
4070	FLATEBY	-0.1	13.5	99
4260	SKEDSMO - HELLERUD	1.4	19.6	218
4290	SKEDSMO - BRÅNÅS			
4440	HAKADAL - BLIKSRUDHAGAN	-2.8	20.1	152
4730	FURUSMO	-1.1	18.2	213
4740	UKKESTAD	0.3	15.0	129
4780	GARDERMOEN	-0.8	11.6	67
4800	SØRUM - SÆTER			
4850	RÅNÅSFOSS	4.6	20.2	141
4890	NES - HORGEN			
4940	HVAM - TOLVHUS	4.2	15.3	110
5050	SAGSTUA VED ÅRNES			
5350	NORD-ODAL	0.5	15.2	135
5450	GALTERUD			
5650	VINGER	2.6	12.9	74
5800	MELDALEN	-1.6	18.2	154
6040	FLISA	0.0	12.1	86
6440	VERMUNDSJØEN	3.5	13.7	99
6490	RUNDBERGET	-1.9	17.1	158

6550	ØRBEKKEDALEN	-4.2	18.2	95
6620	ELVERUM - FAGERTUN	0.0	12.9	79
7010	HAUGEDALSHØGDA	-3.1	19.5	112
7250	OSSJØEN	1.7	13.3	92
7360	OSDALEN - BEKKEN			
7460	OSA KRAFTVERK			
7570	NORDRE LØSSET	-3.9	18.4	176
7660	ÅKRESTRØMMEN	5.4	16.8	108
7830	ELVÅL	0.9	10.5	84
7900	FINSTAD	-1.8	14.7	163
8130	EVENSTAD - ØVERENGET	-1.4	17.0	153
8340	ATNA - NORDRE NESSET			
8450	ATNDALEN - RØNNINGEN	3.4	16.9	184
8710	SØRNESSET	-1.7	21.5	159
8720	ATNASJØ	0.0	14.1	78
8770	ATNDALEN - ERIKSRUD	0.9	11.8	61
8970	EINUNNA KRAFTVERK	0.1	15.0	112
9100	FOLDAL	4.2	13.3	85
9870	BLANKTJERNMOEN I KVIKNE	3.2	20.1	125
10100	OS I ØSTERDAL	4.8	16.4	87
10400	RØROS	2.5	15.2	106
10600	AURSUND	-2.1	15.0	96
10740	BREKKEN	4.0	14.7	76
10900	VAULDALEN	1.4	17.3	107
11050	SVANFOSS	0.9	14.0	152
11080	HJÆRA	0.4	16.6	245
11120	EIDSVOLL VERK	0.5	12.8	82
11240	JEPPEDALEN	-1.2	19.6	161
11350	ROGNLIEN	-2.0	15.5	115
11610	GJØVIK	0.4	13.0	74
11710	EINAVATN	0.6	18.7	113
11900	BIRI	-2.4	17.0	121
12080	STANGE - ALM			
12100	STANGE - FOKHOL	3.2	13.0	90
12200	JØNSBERG LANDBRUKSSKOLE	2.6	14.3	108
12250	ROKO	1.4	16.1	89
12310	HAMAR VANNVERK	2.7	12.7	102
12520	NES PÅ HEDMARK	3.2	16.1	132
12600	VEA	0.5	15.0	105
12680	LILLEHAMMER - SÆTHERENGEN	2.1	13.9	99
12800	MESNA - TYRIA			
12960	SJUSJØEN - STORÅSEN	-9.0	25.3	204
13050	GAUSDAL - SKOGLI	-3.5	19.8	129
13100	VESTRE GAUSDAL	1.3	12.2	80
13310	SØRE BREKKOM	2.1	14.6	101
13420	VENABU	-3.7	15.7	108
13450	HOVDGRENDA	-1.9	20.5	275
13640	OLSTAPPEN	0.2	10.0	83
13670	SKÅBU - STORSLÅEN	-0.1	15.1	82
13700	ESPEDALEN	-5.9	17.9	103
13900	BYGDIN	-11.9	31.6	240
14050	SJOA	1.3	13.0	157
14310	OTTA - BREDVANGEN	2.5	7.7	37
14550	PRESTSTULEN	-1.6	16.5	131
14580	VÅGÅMO - N.GRINDSTUGU	2.4	10.4	96
14690	ØVRE TESSA	-1.6	10.1	98
14710	GROV	-0.1	12.4	64
15060	LOM	1.3	12.3	99
15090	LOM - AUKRUST	-1.3	14.3	167
15430	BØVERDAL	1.7	15.9	94
15480	SKJÅK II	3.5	10.7	85
15630	VIKHØ			
15660	SKJÅK	4.2	14.8	116
15720	BRÅTÅ	-1.1	20.3	149
16240	TOLSTADÅSEN	1.8	10.3	72
16270	HØVRINGEN	-0.2	15.1	115
16610	FOKSTUA II	-0.8	19.7	207
16740	KJØREMSGRENDI	-0.5	16.1	181
16790	LESJA - SVANBORG	2.1	11.4	96

16850	LORA - LEIRMO	2.6	15.1	88
17150	RYGGE	0.4	12.6	74
17250	MOSS	1.9	13.0	76
17290	JELØY	3.5	16.6	155
17500	FLØTER	-3.8	17.2	187
17740	DRØBAK - ULLERUD	-2.0	18.5	96
17770	NESODDEN - TEIGEN			
17780	BLEKSLITJERN			
18040	RUSTADSAGA			
18160	NORDSTRAND	4.2	22.8	249
18250	ALUNSJØEN VED OSLO	-0.6	19.9	144
18450	MARIDALSOSET	0.5	14.9	104
18500	BJØRNHOLT I NORDMARKA	-6.7	26.0	202
18550	HAKLOA I NORDMARKA	-5.7	25.0	185
18700	OSLO - BLINDERN	2.5	21.7	302
18850	SMESTAD II	2.2	20.9	243
18960	TRYVASSHØGDA II	-10.3	30.8	219
19100	KJELSÅS I SØRKEDALEN	-1.9	28.9	308
19200	STORFLÅTAN I NORDMARKA	-2.9	17.2	128
19400	FORNEBU	4.3	15.0	97
19480	DØNSKI	-2.7	18.5	179
19490	GJETTUM	-0.2	17.8	194
19530	AUREVANN	-7.2	26.8	286
19710	ASKER	-1.8	21.2	234
19850	HURUM	0.0	15.6	115
19930	GLITRE			
20250	HOLE	8.1	20.6	117
20520	LUNNER	3.4	19.0	125
20740	BRANDBU - VEST	3.7	15.2	98
21360	ODNES	0.8	12.8	98
21680	VEST-TORPA II	-1.6	12.6	79
21770	NORD TORPA - STAUM	-1.7	14.4	138
21860	ETNEDAL - ØYEN S.	-3.2	14.5	85
22360	KILLINGSTRØMMEN			
22610	MO I ÅDAL	1.3	12.0	64
22730	HEDAL I VALDRES II	0.5	19.6	138
22840	REINLI	-3.0	21.3	134
22950	NORD-AURDAL II	-0.9	12.6	74
23160	ÅBJØRSBRÅTEN	-0.3	14.7	164
23400	LYKKJA I HEMSEDAL			
23420	FAGERNES	0.4	14.9	109
23560	BEITO	0.5	14.8	74
23600	RØN			
23610	ULVEN			
23720	VANG I VALDRES	8.7	30.9	292
23800	YLJA KRAFTVERK	3.0	18.1	186
23850	TYINKRYSSET	-7.0	30.8	397
24100	ASK PÅ RINGERIKE	6.4	20.2	109
24210	SOKNA II	0.5	12.8	65
24600	GRIMELI I KRØDSHERAD	-0.9	16.5	148
24770	GULSVIK IV	-0.7	19.2	121
24880	NESBYEN - SKOGLUND	0.7	11.2	59
24960	GOL - STAKE	4.6	13.9	87
25100	HEMSEDAL - HØLTO	-4.5	27.5	299
25240	VATS	-1.6	15.8	127
25320	ÅL III	0.6	15.1	131
25540	BAKKO I HOL			
25590	GEILO - GEILOSTØLEN	-1.5	12.4	103
25640	GEILO	-3.2	20.3	259
25840	FINSE	2.6	43.2	421
26160	FOSSUM I MODUM	1.6	19.7	188
26240	HIÅSEN I SIGDAL	-0.2	14.8	123
26380	EGGEDAL III	-2.1	16.7	99
26670	HAKAVIK	1.6	15.0	152
26890	DRAMMEN - MARIENLYST	0.0	16.3	140
27050	SANDE - OREBERG			
27070	ROVE	-0.5	14.4	136
27140	BORREVANNET			
27300	RAMNES	-0.9	14.5	124

27410	MÅKERØY	1.4	17.2	118
27450	MELSOM	-3.4	15.4	103
27500	FERDER FYR	5.6	23.7	187
27600	SANDEFJORD	0.0	14.1	96
27720	SANDEFJORD - BRØNNUM	-1.2	13.5	110
27770	STOKKE - SOLLI	-3.5	28.2	428
27800	HEDRUM	-1.1	19.9	225
27920	LARDAL - HÆRLAND	-2.0	16.8	122
28370	KONGSBERG IV	5.8	23.0	147
28800	LYNGDAL I NUMEDAL	-0.8	14.3	172
28920	VEGGLI	4.0	14.4	110
29230	NORE	-1.6	14.0	91
29310	UVDAL II	2.0	11.8	72
29350	UVDAL KRAFTVERK	1.1	11.4	76
29600	TUNNHOVD	0.3	13.9	155
29790	DAGALI II	3.8	15.3	96
30000	LARVIK	-0.5	16.8	97
30220	MYKLE	-6.5	22.8	154
30230	STAVERN - AGNES	2.1	13.4	65
30260	PORSGRUNN BRANNSTASJON	1.4	14.7	98
30320	SKIEN - ELSTRØM	3.3	12.9	66
30370	BESSTUL I GJERPEN	-10.2	29.6	210
30430	KLOVHOLT			
30530	NOTODDEN	3.6	14.5	123
30570	SVÆLGFOSS III	3.7	13.2	96
30810	TINNOSDAMMEN	1.9	12.7	77
30860	BERGELIGREND	1.8	18.0	197
30870	BUSNESGREND - BRÅTEN	-5.9	22.4	222
31080	TESSUNGDALEN - BAKKHUS	-3.4	16.7	109
31200	ØVRE MÅR			
31250	STRENGEN			
31410	RJUKAN	0.8	14.3	95
31500	FRØYSTUL			
31570	MØSVATN - HAUG	0.1	12.6	84
31600	MØSVATN - FØRNES	0.9	16.9	89
31620	MØSSTRAND II	1.8	16.5	80
31660	MOGEN	1.5	23.7	231
31850	HJARTDAL			
31900	TUDDAL	2.8	12.2	106
31940	REISJÅ I TUDDAL	-3.4	13.9	85
32080	GVARV - LINDEM	4.5	19.3	167
32200	LIFJELL	-3.6	16.5	129
32310	SELJORD PRESTEGÅRD	4.1	25.9	208
32350	ÅMOTSDAL	-5.5	20.1	131
32780	HØIDALEN I SOLUM	2.5	15.1	98
32850	KVITESEID - MOEN	3.0	12.7	78
32900	HØYDALSMO	0.5	12.7	94
32920	ØYFJELL - TROVATN			
32930	ØYFJELL I TELEMARK			
33250	RAULAND	2.5	14.6	92
33560	VINJESVINGEN	-8.6	32.2	244
33910	VÅGSLI I VINJE II	-5.7	25.7	221
33960	HAUKELISETER BRØYTESTASJON	12.5	37.3	341
34120	JOMFRULAND FYR	2.8	18.2	114
34400	FARSJØ	-1.3	16.1	118
34600	DRANGEDAL	2.1	18.2	148
34790	TØRDAL II	-2.9	15.2	81
34900	POSTMYR I DRANGEDAL	-2.7	19.0	151
35090	EIKELAND	-2.7	18.5	137
35200	GJERSTAD I AUST-AGDER	-2.0	15.2	170
35340	RISØR BRANNSTASJON	-0.9	18.7	104
35590	VEGÅRSHEI - SPILLING	-2.0	13.4	124
35860	LYNGØR FYR	3.4	27.0	204
36000	LILLEVÅJE			
36060	ARENDAL BRANNSTASJON	3.2	24.4	256
36200	TORUNGEN FYR	5.6	27.8	167
36300	REIERSØL	-2.7	19.9	144
36490	BØYLEFOSS	-1.2	21.4	304
36560	NELAUG	-1.7	21.2	154

36880	SMELAND	-4.8	19.4	129
36970	TOVSLID	-2.7	15.3	105
37040	KATTERÅS	1.6	15.0	121
37090	HØGEFOSS	2.3	11.9	85
37230	TVEITSUND	-0.1	14.6	83
37300	FJALESTAD	-0.1	12.9	114
37450	VRÅDAL - HOLTE	1.3	16.5	110
37500	FOLDSÆ	1.3	19.0	151
37570	BORSÆ			
37650	KILEGREND	0.8	11.4	77
37750	FYRESDAL	3.2	13.7	83
37800	FYRESDAL - LAUVDAL	3.0	13.0	99
38380	DOVLAND	-2.9	17.5	192
38420	RISLÅ	-5.1	25.8	250
38450	HEREFOSS	1.7	15.2	152
38600	MYKLAND	5.0	17.6	112
38800	TOVDAL	0.9	14.5	75
39040	KJEVIK	2.6	16.9	93
39100	OKSØY FYR	10.3	40.2	343
39220	MESTAD I ODDERNES	-10.4	36.6	312
39550	HANNÅSMYRAN	-1.9	19.5	108
39690	BYGLANDSFJORD - SOLBAKKEN	0.8	17.4	135
39840	AUSTAD - EKRON	2.8	18.9	111
40200	BROKKE KRAFTSTASJON	-1.1	18.6	110
40270	HOMME	0.2	18.1	92
40420	BYKLE - KULTRAN	-2.9	30.3	293
40900	BJÅEN	-6.4	29.3	203
41110	MANDAL II	3.1	45.8	349
41170	USLAND			
41180	LAUDAL KRAFTSTASJON	-6.1	24.5	156
41200	FINSLAND	3.8	20.3	123
41370	BJELLAND KRAFTVERK	7.4	26.6	158
41450	SKJERKA	-9.2	32.8	242
41480	ÅSERAL	-9.9	27.2	191
41550	LJOSLAND - MONEN	5.4	25.7	176
41640	VIGMOSTAD	-14.5	34.3	199
41670	KONSMO - HØYLAND	-1.1	24.2	77
41770	LINDESNES FYR	22.2	68.5	573
41820	KVÅVIK	-2.4	29.8	227
41860	KVINESHEI - SØRHELLE	-17.0	54.6	518
42160	LISTA FYR	24.8	66.1	567
42250	FEDAFJORDEN II	-7.4	32.4	292
42350	GALLDAL			
42520	RISNES I FJOTLAND	-2.0	25.2	131
42650	FLEKKEFJORD	-15.3	45.2	472
42720	BAKKE	4.0	28.3	201
42790	TONSTAD - FINSÅ	2.4	22.9	168
42810	TONSTAD - NETTFED	-1.0	24.7	148
42890	SKREÅDALEN	-5.9	30.8	196
42920	SIRDAL - TJØRHOM	4.9	24.2	129
42950	ØVRE SIRDAL	9.8	36.3	242
43090	JØSSINGFJORD			
43340	NORDRE EIGERØY	17.1	54.3	390
43360	EGERSUND	12.7	43.5	301
43450	HELLELAND	6.7	35.2	229
43500	UALAND - BJULAND	-2.8	37.1	238
43540	ØRSDALEN	-17.1	54.7	380
43810	MAUDAL	-26.5	56.0	448
44150	NÆRBØ - SØYLAND			
44160	HOGNESTAD	13.1	37.7	255
44240	TIME			
44250	TIME - SKJÆRET	-16.9	52.3	239
44290	SØR-BRAUT			
44480	SØYLAND I GJESDAL	-15.3	39.7	342
44520	HELLAND I GJESDAL	-6.1	29.5	215
44560	SOLA	17.8	39.1	239
44600	RENNESØY - GALTA	20.5	41.3	265
44760	IMS	2.4	27.7	124
44800	SVILAND	0.5	23.5	121

44900	OLTEDAL	-2.2	48.5	326
44960	MADLAND	-2.2	37.9	445
45200	LYSEFJORDEN	10.4	53.1	434
45350	LYSEBOTN	-6.8	72.7	756
45600	BJØRHEIM I RYFYLKE	6.8	39.9	244
45880	FISTER - TØNNEVIK			
46050	ULLA	-7.3	52.5	475
46150	SAND I RYFYLKE II	-3.5	38.7	263
46200	SULDAL - MO	10.1	37.3	200
46300	SULDALSVATN	-3.5	43.4	506
46400	NESFLATEN	-5.4	46.2	494
46450	RØLDAL	-7.4	35.4	407
46460	RØLDAL KRAFTVERK	1.2	29.4	216
46510	MIDTLÆGER	3.6	79.7	563
46610	SAUDA	-0.4	39.5	276
46700	HELLANDSBYGD			
46850	HUNDSEID I VIKEDAL	-20.6	56.2	434
46910	NEDRE VATS	-11.4	38.4	318
47020	NEDSTRAND	0.9	39.2	243
47090	SKJOLD - FRØVIK	-0.4	33.3	208
47200	SKUDENES II			
47210	SKUDENES III			
47240	KARMØY - BREKKEVANN			
47270	KARMØY - HYDRO			
47300	UTSIRA FYR	18.4	51.7	272
47390	HAUGESUND - ROSSABØ	5.9	31.2	194
47450	STRAUMØY	0.3	31.1	285
47500	ETNE	12.4	50.1	352
47600	LITLEDAL	0.1	47.9	400
47750	VINTERTUN	-20.5	65.2	589
47820	EIKEMO	-10.8	53.5	460
47890	OPSTVEIT	-25.8	79.2	781
48050	BØMLO - FINNÅS	6.0	26.2	154
48090	LITLABØ - DALE	1.3	41.3	205
48160	BØRTVEIT PÅ STORD	-31.3	71.5	479
48250	FITJAR - PRESTBØ	14.3	32.0	160
48330	SLÅTTERØY FYR	10.6	37.5	228
48390	UPSANGERVATN			
48450	HUSNES	13.1	45.3	269
48500	ROSENDAL	22.8	56.9	427
48780	MAURANGER KRAFTSTASJON			
49070	KVÅLE	12.2	72.8	509
49350	TYSSEDAL I	11.7	63.9	583
49390	SKJEGGEDAL II			
49450	TYSSEDAL III			
49460	TYSSEDAL IV			
49550	KINSARVIK	17.4	35.8	258
49580	EIDFJORD - BU	-1.7	49.5	479
49630	EIDFJORD	11.8	28.4	166
49750	LISET	0.4	30.3	170
49870	SIMADAL			
49940	GRANVIN	-16.5	42.1	246
50050	NEDRE ÅLVIK	-27.2	75.5	551
50080	ØYSTESE - BORGE	10.1	55.3	419
50120	SKULAFOSSEN KRAFTSTASJON	2.9	55.8	526
50130	OMASTRAND	1.5	33.7	228
50150	HATLESTRAND	12.7	51.5	416
50250	TYSSE	2.1	45.7	257
50300	KVAMSKOGEN	-16.8	57.0	343
50350	SAMNANGER	-23.4	66.7	560
50450	FANA - STEND	11.1	49.1	329
50540	BERGEN - FLORIDA	-0.9	33.2	189
50860	GULLFJELL - OSAVANN	-23.6	66.0	522
51100	FOSSE I BERGSDAL			
51130	KALDESTAD			
51250	ØVSTEDAL	-14.2	67.7	573
51400	BREKKHUS	-1.9	31.6	174
51470	BULKEN	14.7	38.3	275
51590	VOSS - BØ	25.8	52.2	538

51670	REIMEGREND	3.9	44.1	614
52110	FJELLANGER II	4.1	29.4	137
52170	EKSINGEDAL	-4.2	33.5	245
52220	GULLBRÅ	8.5	28.1	167
52290	MODALEN II	-20.3	49.6	267
52400	EIKANGER - MYR	18.7	40.1	230
52440	HOLSNØY - LANDSVIK	13.8	44.9	289
52530	HELLISØY FYR	30.1	48.9	446
52600	HAUKELAND	-31.4	72.5	504
52640	MATRE KRAFTSTASJON	10.0	37.8	202
52750	FRØYSET	15.7	60.9	288
52860	TAKLE	-14.2	60.0	384
52930	BREKKE I SOGN	-40.6	73.7	448
52990	ORTNEVIK	21.2	53.2	498
53070	VIK I SOGN III	8.8	29.7	237
53080	VIK - VANGE	12.8	36.3	333
53100	VANGSNES	10.7	42.6	488
53130	FRESVIK	12.8	30.6	239
53160	JORDALEN - NÅSEN	-12.4	40.0	359
53180	BRANDSET	1.5	31.3	196
53260	UNDERDAL			
53410	MYRDAL IV	-0.5	50.3	369
53700	AURLAND	17.0	33.3	213
53730	GRIMSETE			
53950	AURLAND - ØYESTØL			
54130	LÆRDAL - TØNJUM	11.0	25.0	186
54320	BORGUND - LO			
54420	ØLJUSJØ PUMPEKRAFTVERK			
54500	BORLO	5.8	18.3	166
54600	MARISTOVA	-2.2	22.8	183
54780	ØVRE ÅRDAL	-0.9	24.5	166
54900	VETTI	-6.2	35.3	303
55160	FORTUN	9.3	22.0	146
55170	SKAGEN	1.5	18.3	206
55270	SKÅLAVATN			
55390	LEIRDAL	-4.2	43.7	331
55400	MYKLEMYR	-5.7	26.9	233
55430	BJØRKEHAUG I JOSTEDAL	-2.1	31.7	246
55550	HAFSLO	8.9	31.9	212
55670	VEITASTROND	-10.2	34.1	252
55730	SOGNDAL - SELSENG	-3.7	35.7	209
55840	FJÆRLAND - SKARESTAD	-13.3	35.3	204
56010	HØYANGER VERK	-14.6	57.8	506
56120	HØYANGSHÅLAND			
56280	RØRVIKVATN VED VADHEIM	-18.0	43.6	291
56320	LAVIK	28.4	59.2	390
56400	YTRE SOLUND	-6.9	43.9	277
56480	VÆRLANDET	-5.3	33.1	203
56520	HOVLANDSDAL	-9.5	46.6	292
56560	GUDDAL	1.3	38.9	188
56650	DALE I SUNNFJORD II	1.4	45.6	278
56800	GAULAR	17.4	35.7	242
56850	VIKSDALEN I GAULAR	-1.6	34.4	153
56960	HAUKEDAL	-19.9	44.9	429
57110	OSLAND VED STONGFJORDEN	-21.4	79.2	565
57190	FØRDE - VIE			
57390	SKEI I JØLSTER	-4.4	30.7	201
57480	BOTNEN I FØRDE	-20.7	49.2	602
57610	GRYTA	16.1	65.1	368
57660	EIMHJELLEN	-9.0	45.0	316
57680	EIKEFJORD	0.4	49.3	333
57770	YTTERØYANE FYR	14.5	46.2	293
57780	GRØNDALEN	-42.7	95.7	964
57810	SVELGEN II	6.6	51.6	344
57850	DAVIKNES	16.5	49.9	257
57940	ÅLFOTEN II	2.4	62.6	321
57990	GJENGEDAL	-2.6	36.4	230
58070	SANDANE	29.3	54.3	557
58120	KLAKEGG - BOLSET	-9.6	40.5	291

58320	MYKLEBUST I BREIM	-0.2	41.1	341
58400	INNVIK	19.2	36.3	233
58430	OLDEN - VANGBERG			
58480	BRIKSDAL	11.6	30.8	194
58780	NORDFJORDEID - NYMARK	-0.3	37.1	225
58880	SINDRE	1.0	28.5	178
58960	HORNINDAL	-8.3	29.8	182
59200	ULVESUND	9.0	66.7	580
59450	STADLANDET	-10.0	51.5	471
59560	BRANDAL	-19.6	58.8	515
59610	FISKÅBYGD	-1.8	48.0	559
59670	EKSET I VOLDA	13.2	40.2	431
59690	ØRSTA VEGSTASJON			
59710	ØRSTAVIK - VELLE	-11.0	40.0	238
59800	SVINØY FYR	47.9	90.3	825
59900	SÆBØ	-14.3	48.2	382
60210	STRANDA VEGSTASJON	10.8	35.8	302
60300	GEIRANGER	-2.4	29.5	161
60400	NORDDAL	12.7	27.7	190
60500	TAFJORD	11.6	35.6	382
60620	GRØNNING	-3.4	26.3	200
60710	STORDAL - OVERØYE	-21.9	58.1	440
60800	ØRSKOG	-0.5	50.7	226
60890	BRUSDALSVATN II	-7.4	30.4	179
60970	ÅLESUND III	7.4	28.4	216
60990	VIGRA	10.3	32.0	228
61040	HILDRE	3.0	27.5	177
61100	VESTNES VEGSTASJON			
61170	HJELVIK I ROMSDAL	6.0	41.9	352
61350	ÅNDALSNES	3.6	30.6	302
61400	ÅNDALSNES VEGSTASJON			
61550	VERMA	12.1	24.4	170
61770	LESJASKOG	-0.9	16.3	113
61820	ERESFJORD	-7.2	31.8	288
61850	EIKESDAL	0.9	22.6	132
62160	ISTAD KRAFTSTASJON	-2.7	33.2	314
62480	ONA II	1.2	35.7	319
62700	HUSTADVATN	-7.5	42.1	239
62900	EIDE PÅ NORDMØRE	-14.9	56.2	437
63100	ØKSENDAL	-0.7	25.5	225
63420	SUNNDALSØRA III	12.4	33.4	239
63530	HAFSÅS	11.2	25.7	124
63580	ÅNGÅRDSVATNET	9.1	23.9	235
63590	KLETTHAMMER - SÆTEREN			
63710	OPPDAL - BJØRKE			
63750	MJØEN	5.2	17.6	101
64320	KRISTIANSUND ELVERK			
64460	HALSAFJORD II	-14.3	49.5	370
64510	TINGVOLL GÅRD	3.9	28.9	305
64550	TINGVOLL - HANEM	5.3	26.3	200
64580	ÅLVUNDFJORD	-1.3	30.7	207
64620	REINSET KRAFTSTASJON			
64700	INNERDAL	-13.1	76.2	1126
64780	SURNADAL - MOEN	-12.1	35.3	250
64800	SURNADAL	0.7	21.5	143
64900	RINDAL	6.6	33.0	237
65100	VINJEØRA	-5.9	28.8	217
65110	VINJEØRA II	0.1	25.8	163
65150	AUREDALEN	-7.7	40.2	418
65220	HEMNE	-5.9	36.1	329
65270	SØVATNET	-11.2	35.0	373
65300	SKALMEN FYR	10.1	34.0	305
65370	SMØLA - MOLDSTAD			
65450	SANDSTAD	3.0	44.1	409
65600	HITRA	1.9	24.6	134
65940	SULA	6.5	31.5	189
66010	SELVA			
66030	LENSVIK	-2.5	27.4	185
66070	SKJENALDFOSSEN I ORKDAL	-2.1	24.9	161

66100	SONGLI	-12.1	39.6	311
66180	ORKDAL - ØYUM	1.7	16.4	81
66190	LØFTEN	3.2	21.2	150
66210	HOSTON	1.7	19.9	164
66250	HØLONDA	1.0	31.3	474
66580	NERSKOGEN II	-3.1	22.5	150
66620	RENNEBU - RAMSTAD	-2.9	26.7	168
66730	BERKÅK - LYNGHOLT	-1.5	25.9	186
66850	KVIKNE I ØSTERDAL	-1.1	18.9	138
67040	SKAUN - SYRSTAD			
67050	SKAUN - ROSMO	3.3	16.0	101
67150	LEINSTRAND	6.7	23.8	219
67170	HAVDAL - OPPIGARD			
67200	LUNDAMO	-0.5	16.0	85
67240	STØREN - VÅRVOLL	0.0	16.5	96
67450	ENDALSVOLL	0.7	21.5	107
67540	RØSBJØRGEN	-1.1	17.1	95
67770	HALTDALEN III	-2.7	22.3	148
68000	BYNESET	9.9	24.6	188
68180	TRONDHEIM - NIDARVOLL			
68270	LØKSMYR	-4.7	23.7	206
68330	LIEN I SELBU	4.1	22.4	120
68340	SELBU - STUBBE	0.7	23.9	151
68420	AUNET	0.7	17.9	97
68450	NEA KRAFTVERK	-0.8	21.1	155
68840	STUGUDAL - KÅSEN	-5.2	26.4	250
69100	VÆRNES	8.4	18.6	118
69230	HEGRA II	-9.6	28.7	194
69330	MERÅKER - KROGSTAD	-7.2	31.6	304
69410	ROTVOLL	2.0	23.3	150
69470	KOPPERÅ	-0.8	24.6	116
69550	ØSTÅS I HEGRA	-9.1	29.9	212
69660	FROSTA - JUBERG	10.9	25.4	224
69960	BURAN	2.2	28.2	226
70120	VERDAL - STIKLESTAD			
70150	VERDAL - REPPE	5.1	15.0	43
70340	VERDAL - SUL	-7.7	29.6	183
70370	SULSTUA			
70480	SKJÆKERFOSSEN	-14.8	36.5	343
70500	VERA	3.4	25.5	167
70670	MÆRE			
70820	UTGÅRD	4.5	23.2	147
70850	KJØBLI I SNÅSA			
71150	SELAVATN	-5.2	29.5	190
71200	MOSVIK - TRØAHAUGEN	8.9	30.8	178
71280	LEKSVIK - MYRAN	-5.2	29.1	184
71350	RISSA	-17.5	46.3	485
71370	SLIPER	-18.0	45.4	494
71550	ØRLAND III	7.3	30.6	226
71750	BREIVOLL	-10.0	43.2	454
71810	ÅFJORD - MOMYR	-22.6	58.2	501
71850	HALTEN FYR	4.0	35.1	196
71900	BESSAKER	12.8	46.2	532
71990	BUHOLMRÅSA FYR	17.7	44.5	377
72050	NAMDALSEID - JAMTSVE			
72100	NAMDALSEID	3.6	26.7	188
72250	BANGDALEN	-3.7	24.3	118
72650	OVERHALLA - UNNSET	3.4	25.7	209
73250	SØRLI	-10.7	30.8	247
73500	NORDLI - HOLAND	3.9	19.0	74
73620	HARRAN	-22.9	54.3	448
73800	TUNNSJØ	-5.4	23.8	143
74160	RØYRVIKFOSS	-15.9	31.6	248
74320	TRONES - TROMSSTAD	1.6	27.8	207
74510	SANDÅMO	-4.1	29.4	238
74800	NAMSVATN	-15.7	35.2	383
75020	OTTERØY	-5.0	34.1	263
75100	LIAFOSS	-21.9	51.6	363
75150	VAL LANDBRUKSSKOLE	14.1	41.1	330

75270	RØRVIK - ENGAN	-6.5	22.1	188
75410	NORDØYAN FYR	-0.3	23.0	133
75550	SKLINNA FYR	5.6	27.5	190
75600	LEKA	-11.2	30.4	233
76100	ØKSNINGØY	3.7	36.2	223
76250	SØMNA - STEIN	-10.7	32.8	188
76270	TRÆLNES			
76380	SAUSVATN - SKOGMO	-18.8	50.3	450
76450	VEGA - VALLSJØ			
77270	FALLMOEN	-2.8	34.3	316
77290	SVENNINGDAL	-5.0	28.8	245
77420	MAJAVATN III	-9.2	27.9	198
77510	FIPLINGDAL II	-4.1	27.8	171
77750	SUSENDAL - BJORMO	4.5	28.1	175
77850	SUSENDAL	12.4	36.0	239
78100	DREVJA	-4.4	40.7	350
78250	LEIRFJORD	11.6	59.5	504
78350	BARDAL	15.2	45.4	444
78420	KORGEN - AURINGMOEN	2.7	34.5	232
78610	TUSTERVATNET II	1.0	34.0	248
78770	FAMVATNET	20.1	38.9	205
78850	RØSSVATN - HEGGMO	-16.4	38.1	248
79480	MO I RANA III	-0.2	39.4	366
79530	RANA - BÅSMOEN	-11.4	35.9	333
79640	GRØNLIGROTTEN	-16.1	52.5	437
79670	RØVASSDALEN	-5.7	37.2	269
79710	GRØNFJELLDAL	16.9	59.8	567
79740	DUNDERLANDSDALEN	-13.5	54.7	531
80100	NORD-SOLVÆR			
80200	LURØY	-35.7	87.7	763
80340	TRÆNA - HUSØY			
80350	TRÆNSTAVEN			
80650	HALSA I HELGELAND	20.9	47.7	357
80700	GLOMFJORD	-4.7	46.8	333
80850	SUNDSFJORD	-17.7	52.7	358
80950	TENNHOLMEN FYR			
81080	BEIARN - NAUSTVOLD	-2.8	25.7	209
81250	LEIRÅMO	14.7	41.8	315
81360	BØRNUPVATN			
81370	OLDEREID KRAFTSTASJON	-6.4	30.4	257
81680	SALTDAL	11.5	21.6	143
81730	JUNKERDAL	1.6	24.8	246
81770	LØNSDAL	3.6	25.5	202
81900	SULITJELMA	-14.4	52.8	539
81930	STORSTILLA			
81940	COARVE			
81950	BALVATN			
82160	HEGGMOEN VED BODØ			
82290	BODØ VI	17.8	49.5	361
82560	KJERRINGØY - STRANDÅ	-7.6	36.3	250
82650	VALLJORD			
82800	KOBBELV			
82840	STYRKESNES - HESTVIKA	1.1	42.1	265
83300	STEIGEN	-8.1	31.5	220
83500	KRÅKMO	-2.0	40.7	329
83520	TØMMERNESET	-11.3	49.6	441
83550	FINNØY I HAMARØY	7.5	39.7	304
83880	SØRFJORD KRAFTVERK	-8.1	38.3	223
84070	BJØRKÅSEN	-9.8	34.1	291
84170	SKJOMEN - SLETTJORD	7.1	21.0	182
84190	SKJOMEN - STIBERG	4.0	28.0	193
84450	ANKENES	-4.3	26.3	155
84800	NARVIK III	-1.5	29.4	239
84960	LILAND	-4.7	28.1	192
85060	KANSTADBOTN IV	-22.4	63.8	497
85180	RINBØ	0.6	43.3	272
85200	YTTERSTAD	8.0	33.4	233
85380	SKROVA FYR	16.7	45.4	348
85440	KVITFOSSEN I VÅGAN			

85470	KONGSMARKA			
85540	LEKNES I LOFOTEN	34.9	84.1	753
85660	REINE	-34.9	84.1	753
85910	RØST II			
86470	SØRKLEIVDALEN	-1.9	37.3	186
86500	SORTLAND	0.4	29.3	186
86760	BØ I VESTERÅLEN II	10.0	33.4	209
86850	BARKESTAD	-8.2	27.3	127
86950	ALSVÅG I VESTERÅLEN II	4.3	25.8	164
87110	ANDØYA			
87350	BORKENES	20.2	39.6	235
87550	ERVIK	10.8	29.4	145
87750	GAUSVIK			
87860	GROVFJORD			
87940	GRATANGEN III	3.2	31.0	196
88000	TENNEVOLL	-11.3	36.6	235
88100	BONES I BARDU	0.1	28.0	129
88350	TRANØYBOTN II	-3.1	33.2	188
88460	GRUNNFARNES	-8.7	35.6	276
88660	BOTNHAMN	-7.5	31.9	274
88690	HEKKINGEN FYR	10.2	30.3	264
89110	MÅLSELV - GRUNDNES	-3.9	26.9	160
89350	BARDUFOSS	12.1	25.9	205
89500	SÆTERMOEN II	2.3	23.4	128
89650	INNSET I BARDU			
89800	ØVERBYGD	2.3	18.4	100
89950	DIVIDALEN	10.6	28.9	182
90080	MESTERVIK	-1.5	16.9	101
90200	STORSTEINNES I BALSFJORD	-1.0	16.6	108
90450	TROMSØ	-1.8	15.2	105
90490	TROMSØ - LANGNES	1.5	14.5	75
90570	LYFJORD	-0.5	26.9	137
90650	GRUNNFJORD - STAKKEN	-6.7	34.2	319
90800	TORSVÅG FYR	-0.5	24.3	136
90900	FUGLØYKALVEN FYR	7.2	23.8	183
91110	ULLSFJORD II	-7.4	24.8	199
91250	LYNGSEIDET III	1.8	17.4	94
91300	OTEREN	-11.0	38.7	498
91370	SKIBOTN - FOSSBAKK	4.7	29.7	174
91400	SKIBOTN KRAFTVERK			
91440	HELLIGSKOGEN MILITÆRLEIR	-0.9	18.9	115
91520	MANNDALEN	2.7	18.3	142
91600	GUOLASJÅKKA KRAFTVERK			
91700	SKJERVØY - KOBBEPOLLEN			
91750	NORDREISA			
91760	NORDREISA - ØYENG	-10.2	27.1	142
91930	REISADALEN - BJØRKLI	2.2	16.1	103
92210	KVÆNANGSBOTN II	-1.2	20.4	212
92350	NORDSTRAUM I KVÆNANGEN	-0.6	17.6	177
92700	LOPPA			
92750	HASVIK LUFTHAVN			
92900	LANGFJORDBOTN	1.0	28.9	174
93140	ALTA LUFTHAVN	13.3	34.7	230
93300	SOLOVOMI	0.2	17.6	109
93500	JOTKAJAVRE	-1.2	15.0	82
93650	BIDJOVAGGE	-2.4	27.5	208
93710	KAUTOKEINO II	3.3	27.8	204
93900	SICCAJAVRE			
94130	PORSA II	-13.3	34.7	230
94180	SKAIDI			
94500	FRUHOLMEN FYR			
94700	HELNES FYR			
94800	REPVÅG			
95270	SKOGANVARRE II	-0.6	18.0	145
95350	BANAK	4.5	19.4	124
95610	BØRSELV - HØGBAKKEN	-6.4	24.7	171
95900	VEIDNES I LAKSEFJORD	4.0	23.1	176
96000	ADAMSELV KRAFTVERK	-0.2	20.7	125
96220	LEBESBY - KARLMYHR	-3.8	19.9	168

96400	SLETNES FYR			
96800	RUSTEFJELBMA	0.2	28.3	284
96930	POLMAK	-0.2	19.2	206
96970	SIRMA	0.2	17.6	128
97110	PORT	3.4	15.2	120
97150	VALJOK	-3.0	14.1	125
97250	KARASJOK	0.7	13.3	95
97320	JERGUL	0.5	13.4	127
97350	CUOVDATMÅKKI	0.3	13.7	109
97580	MOLLISJOK	0.2	16.5	128
97690	ISKURASJOK	-0.6	18.4	191
98060	BERLEVÅG - BAKKETUN			
98400	MAKKAUR FYR			
98550	VARDØ	-3.4	27.3	244
98650	SKALLELV	3.4	27.3	244
98850	VESTRE JAKOBSELV	3.5	20.4	129
99100	GANDVIK	-2.1	22.5	166
99330	VEINES I NEIDEN	-1.3	27.6	268
99370	KIRKENES LUFTHAVN	2.5	14.5	101
99450	BJØRNSUND	1.8	15.9	144
99500	SKOGFOSS	-2.3	18.0	201
99530	PASVIK	2.1	23.5	213
99690	LANABUKT	-4.2	19.4	172
99710	BJØRNØYA			
99720	HOPEN			
99760	SVEA GRUBER			
99840	SVALBARD LUFTHAVN			
99910	NY-ÅLESUND II			
99950	JAN MAYEN			

APPENDIX 3

Estimation power of improved method.

The table below shows bias, standard error and maximal absolute error in a unit of one tenth of a millimeter of precipitation when evaluating the estimator in section 3. Quality controlled data from the period 1. January - 31. December 1992 (365 observations for each station) is used in order to generate statistics.

Stations without statistics have no reference stations.

STNR	NAVN	BIAS	S.E.	M.A.E.
60	LINNES	0.0	17.6	107
100	PLASSEN	0.0	17.9	146
290	TÅGMYRA	0.0	16.8	107
420	HEGGERISET - NORDSTRAND	0.0	16.4	103
600	GLØTVOLA	0.0	14.2	132
700	DREVSJØ	0.0	12.5	104
730	VALDALEN	0.0	22.4	205
770	ELLEFSPLASS	0.0	14.7	103
810	TUFSINGDAL - MIDTDAL	0.0	15.0	108
900	LANGEN	0.0	25.7	142
1080	HVALER	0.0	16.1	102
1130	PRESTEBAKKE	0.0	21.6	146
1230	HALDEN	0.0	15.5	91
1400	BREKKE SLUSE	0.0	16.6	152
1650	STRØMSFOSS SLUSE	0.0	13.2	68
1950	ØRJE	0.0	13.7	137
2170	SETTEN	0.0	14.5	89
2540	HØLAND - FOSSER	0.0	12.0	80
2610	BJØRKELANGEN II	0.0	16.0	92
2910	SKOTTERUD - BERGSTAD	0.0	13.7	152
2950	MAGNOR	0.0	20.9	334
3150	KALNES	0.0	14.6	126
3190	SARPSBORG	0.0	14.1	85
3200	BATERØD			
3280	RAKKESTAD - SANDER			
3450	HAGA I EIDSBERG	0.0	10.7	92
3500	SVARVERUD I EIDSBERG	0.0	16.5	148
3780	IGSI I HOBØL	0.0	12.9	121
3930	TRØGSTAD	0.0	12.5	117
4050	ENEBAKK	0.0	13.9	149
4070	FLATEBY	0.0	12.1	93
4260	SKEDSMO - HELLERUD	0.0	14.3	107
4290	SKEDSMO - BRÅNÅS	0.0	19.9	287
4440	HAKADAL - BLIKSRUDHAGAN	0.0	16.0	103
4730	FURUSMO	0.0	15.2	131
4740	UKKESTAD	0.0	12.0	88
4780	GARDERMOEN	0.0	10.1	60
4800	SØRUM - SÆTER	0.0	17.9	123
4850	RÅNÅSFOSS	0.0	14.2	117
4890	NES - HORGEN	0.0	8.3	73
4940	HVAM - TOLVHUS	0.0	8.0	59
5050	SAGSTUA VED ÅRNES	0.0	15.1	130
5350	NORD-ODAL	0.0	12.9	108
5450	GALTERUD	0.0	14.8	124
5650	VINGER	0.0	10.3	54
5800	MELDALEN	0.0	17.6	156
6040	FLISA	0.0	11.5	85
6440	VERMUNDSJØEN	0.0	11.6	65
6490	RUNDBERGET	0.0	14.6	91
6550	ØRBEKKEDALEN	0.0	15.9	74

6620	ELVERUM - FAGERTUN	0.0	12.7	66
7010	HAUGEDALSHØGDA	0.0	14.5	87
7250	OSSJØEN	0.0	12.8	94
7360	OSDALEN - BEKKEN	0.0	19.5	175
7460	OSA KRAFTVERK			
7570	NORDRE LØSSET	0.0	15.4	117
7660	ÅKRESTRØMMEN	0.0	12.6	96
7830	ELVÅL	0.0	10.6	87
7900	FINSTAD	0.0	13.5	130
8130	EVENSTAD - ØVERENGET	0.0	18.2	153
8340	ATNA - NORDRE NESSET	0.0	12.1	61
8450	ATNDALEN - RØNNINGEN	0.0	13.1	160
8710	SØRNESSET	0.0	20.9	158
8720	ATNASJØ	0.0	14.0	79
8770	ATNDALEN - ERIKSRUD	0.0	12.1	57
8970	EINUNNA KRAFTVERK	0.0	13.9	124
9100	FOLDAL	0.0	11.0	73
9870	BLANKTJERNMOEN I KVIKNE	0.0	18.6	137
10100	OS I ØSTERDAL	0.0	13.3	75
10400	RØROS	0.0	13.5	99
10600	AURSUND	0.0	14.0	69
10740	BREKKEN	0.0	12.6	74
10900	VAULDALEN	0.0	16.5	114
11050	SVANFOSS	0.0	13.3	158
11080	HJÆRA	0.0	14.3	209
11120	EIDSVOLL VERK	0.0	11.0	70
11240	JEPPEDALEN	0.0	17.7	130
11350	ROGNLIEN	0.0	15.8	87
11610	GJØVIK	0.0	12.4	79
11710	EINAVATN	0.0	17.2	112
11900	BIRI	0.0	14.4	103
12080	STANGE - ALM	0.0	20.7	138
12100	STANGE - FOKHOL	0.0	10.8	77
12200	JØNSBERG LANDBRUKSSKOLE	0.0	12.2	99
12250	ROKO	0.0	15.1	85
12310	HAMAR VANNVERK	0.0	11.3	59
12520	NES PÅ HEDMARK	0.0	12.1	71
12600	VEA	0.0	13.9	133
12680	LILLEHAMMER - SÆTHERENGEN	0.0	14.1	139
12800	MESNA - TYRIA			
12960	SJUSJØEN - STORÅSEN	0.0	18.8	140
13050	GAUSDAL - SKOGLI	0.0	17.6	104
13100	VESTRE GAUSDAL	0.0	11.2	84
13310	SØRE BREKKOM	0.0	14.2	96
13420	VENABU	0.0	13.4	77
13450	HOVDGRENDA	0.0	16.5	224
13640	OLSTAPPEN	0.0	8.0	74
13670	SKÅBU - STORSLÅEN	0.0	12.2	69
13700	ESPEDALEN	0.0	11.4	73
13900	BYGDIN	0.0	21.0	144
14050	SJOA	0.0	12.6	162
14310	OTTA - BREDVANGEN	0.0	8.3	60
14550	PRESTSTULEN	0.0	12.8	83
14580	VÅGÅMO - N.GRINDSTUGU	0.0	8.3	87
14690	ØVRE TESSA	0.0	9.0	67
14710	GROV	0.0	11.2	59
15060	LOM	0.0	11.2	71
15090	LOM - AUKRUST	0.0	13.2	127
15430	BØVERDAL	0.0	12.6	79
15480	SKJÅK II	0.0	11.1	109
15630	VIKHØ			
15660	SKJÅK	0.0	11.3	74
15720	BRÅTÅ	0.0	18.4	141
16240	TOLSTADÅSEN	0.0	10.0	85
16270	HØVRINGEN	0.0	14.8	112
16610	FOKSTUA II	0.0	15.9	119
16740	KJØREMSGRENDI	0.0	9.1	71
16790	LESJA - SVANBORG	0.0	9.3	73
16850	LORA - LEIRMO	0.0	15.0	93

17150	RYGGE	0.0	12.3	71
17250	MOSS	0.0	12.6	82
17290	JELØY	0.0	14.5	161
17500	FLØTER	0.0	14.8	130
17740	DRØBAK - ULLERUD	0.0	16.7	80
17770	NESODDEN - TEIGEN			
17780	BLEKSLITJERN			
18040	RUSTADSAGA			
18160	NORDSTRAND	0.0	17.6	225
18250	ALUNSJØEN VED OSLO	0.0	17.4	124
18450	MARIDALSOSET	0.0	13.3	87
18500	BJØRNHOLT I NORDMARKA	0.0	18.8	166
18550	HAKLOA I NORDMARKA	0.0	22.9	149
18700	OSLO - BLINDERN	0.0	19.4	297
18850	SMESTAD II	0.0	19.3	255
18960	TRYVASSHØGDA II	0.0	17.0	109
19100	KJELSÅS I SØRKEDALEN	0.0	25.3	243
19200	STORFLÅTAN I NORDMARKA	0.0	16.0	111
19400	FORNEBU	0.0	11.5	95
19480	DØNSKI	0.0	12.4	119
19490	GJETTUM	0.0	13.6	139
19530	AUREVANN	0.0	20.9	200
19710	ASKER	0.0	18.5	197
19850	HURUM	0.0	13.4	94
19930	GLITRE			
20250	HOLE	0.0	13.6	114
20520	LUNNER	0.0	15.1	86
20740	BRANDBU - VEST	0.0	13.5	84
21360	ODNES	0.0	12.6	89
21680	VEST-TORPA II	0.0	13.0	118
21770	NORD TORPA - STAUM	0.0	13.8	121
21860	ETNEDAL - ØYEN S.	0.0	15.0	106
22360	KILLINGSTRØMMEN			
22610	MO I ÅDAL	0.0	11.3	54
22730	HEDAL I VALDRES II	0.0	19.0	145
22840	REINLI	0.0	22.0	135
22950	NORD-AURDAL II	0.0	12.8	73
23160	ÅBJØRSBRÅTEN	0.0	12.7	139
23400	LYKKJA I HEMSEDAL	0.0	6.8	30
23420	FAGERNES	0.0	12.3	104
23560	BEITO	0.0	13.5	84
23600	RØN			
23610	ULVEN	0.0	14.1	129
23720	VANG I VALDRES	0.0	20.0	183
23800	YLJA KRAFTVERK	0.0	17.8	139
23850	TYINKRYSSET	0.0	26.5	277
24100	ASK PÅ RINGERIKE	0.0	12.2	75
24210	SOKNA II	0.0	11.5	88
24600	GRIMELI I KRØDSHERAD	0.0	15.0	117
24770	GULSVIK IV	0.0	18.4	107
24880	NESBYEN - SKOGLUND	0.0	10.6	57
24960	GOL - STAKE	0.0	11.5	55
25100	HEMSEDAL - HØLTO	0.0	17.1	210
25240	VATS	0.0	14.7	91
25320	ÅL III	0.0	13.5	107
25540	BAKKO I HOL			
25590	GEILO - GEILOSTØLEN	0.0	10.3	55
25640	GEILO	0.0	15.8	175
25840	FINSE	0.0	36.5	328
26160	FOSSUM I MODUM	0.0	18.7	192
26240	HIÅSEN I SIGDAL	0.0	14.3	93
26380	EGGEDAL III	0.0	14.5	96
26670	HAKAVIK	0.0	14.9	123
26890	DRAMMEN - MARIENLYST	0.0	15.9	147
27050	SANDE - OREBERG	0.0	23.1	119
27070	ROVE	0.0	12.9	108
27140	BORREVANNET			
27300	RAMNES	0.0	13.5	106
27410	MÅKERØY	0.0	16.0	88

27450	MELSOM	0.0	13.8	142
27500	FERDER FYR	0.0	20.8	200
27600	SANDEFJORD	0.0	13.3	90
27720	SANDEFJORD - BRØNNUM	0.0	12.4	80
27770	STOKKE - SOLLI	0.0	26.2	427
27800	HEDRUM	0.0	17.3	191
27920	LARDAL - HÆRLAND	0.0	14.4	107
28370	KONGSBERG IV	0.0	15.5	93
28800	LYNGDAL I NUMEDAL	0.0	13.3	126
28920	VEGGLI	0.0	13.7	107
29230	NORE	0.0	13.2	73
29310	UVDAL II	0.0	10.6	88
29350	UVDAL KRAFTVERK	0.0	10.8	60
29600	TUNNHOVD	0.0	12.2	122
29790	DAGALI II	0.0	12.3	109
30000	LARVIK	0.0	15.3	82
30220	MYKLE	0.0	18.0	130
30230	STAVERN - AGNES	0.0	11.6	63
30260	PORSGRUNN BRANNSTASJON	0.0	12.8	90
30320	SKIEN - ELSTRØM	0.0	11.3	69
30370	BESSTUL I GJERPEN	0.0	21.9	142
30430	KLOVHOLT	0.0	16.0	159
30530	NOTODDEN	0.0	11.2	75
30570	SVÆLGFOSS III	0.0	11.8	75
30810	TINNOSDAMMEN	0.0	11.0	66
30860	BERGELIGREND	0.0	17.1	199
30870	BUSNESGREND - BRÅTEN	0.0	16.2	166
31080	TESSUNGDALEN - BAKKHUS	0.0	14.1	105
31200	ØVRE MÅR			
31250	STRENGEN			
31410	RJUKAN	0.0	15.2	102
31500	FRØYSTUL			
31570	MØSVATN - HAUG	0.0	13.6	81
31600	MØSVATN - FØRNES	0.0	16.6	82
31620	MØSSTRAND II	0.0	15.8	83
31660	MOGEN	0.0	21.4	207
31850	HJARTDAL			
31900	TUDDAL	0.0	11.8	116
31940	REISJÅ I TUDDAL	0.0	12.9	80
32080	GVARV - LINDEM	0.0	16.4	145
32200	LIFJELL	0.0	15.1	99
32310	SELJORD PRESTEGÅRD	0.0	21.1	157
32350	ÅMOTSDAL	0.0	16.0	126
32780	HØIDALEN I SOLUM	0.0	13.2	101
32850	KVITESEID - MOEN	0.0	11.9	65
32900	HØYDALSMO	0.0	12.1	83
32920	ØYFJELL - TROVATN	0.0	8.9	33
32930	ØYFJELL I TELEMARK	0.0	13.6	85
33250	RAULAND	0.0	13.5	65
33560	VINJESVINGEN	0.0	28.3	206
33910	VÅGSLI I VINJE II	0.0	24.9	215
33960	HAUKELISETER BRØYTESTASJON	0.0	24.4	118
34120	JOMFRULAND FYR	0.0	15.0	104
34400	FARSJØ	0.0	14.7	101
34600	DRANGEDAL	0.0	16.8	105
34790	TØRDAL II	0.0	13.3	76
34900	POSTMYR I DRANGEDAL	0.0	17.9	130
35090	EIKELAND	0.0	17.5	126
35200	GJERSTAD I AUST-AGDER	0.0	12.9	100
35340	RISØR BRANNSTASJON	0.0	16.9	113
35590	VEGÅRSHEI - SPILLING	0.0	12.8	128
35860	LYNGØR FYR	0.0	23.4	214
36000	LILLEVÅJE	0.0	21.5	146
36060	ARENDAL BRANNSTASJON	0.0	20.0	158
36200	TORUNGEN FYR	0.0	22.2	116
36300	REIERSØL	0.0	17.2	118
36490	BØYLEFOSS	0.0	18.6	254
36560	NELAUG	0.0	17.7	126
36880	SMELAND	0.0	15.7	91

36970	TOVSLID	0.0	14.4	103
37040	KATTERÅS	0.0	13.6	110
37090	HØGEFOSS	0.0	12.0	98
37230	TVEITSUND	0.0	12.3	59
37300	FJALESTAD	0.0	12.2	98
37450	VRÅDAL - HOLTE	0.0	15.8	108
37500	FOLDSÆ	0.0	17.5	135
37570	BORSÆ			
37650	KILEGREND	0.0	11.1	79
37750	FYRESDAL	0.0	13.6	76
37800	FYRESDAL - LAUVDAL	0.0	12.2	100
38380	DOVLAND	0.0	16.7	148
38420	RISLÅ	0.0	22.6	228
38450	HEREFOSS	0.0	14.0	119
38600	MYKLAND	0.0	12.9	81
38800	TOVDAL	0.0	14.0	78
39040	KJEVIK	0.0	20.8	115
39100	OKSØY FYR	0.0	25.2	145
39220	MESTAD I ODDERNES	0.0	26.3	146
39550	HANNÅSMYRAN	0.0	20.7	138
39690	BYGLANDSFJORD - SOLBAKKEN	0.0	21.8	150
39840	AUSTAD - EKRON	0.0	18.7	115
40200	BROKKE KRAFTSTASJON	0.0	21.4	132
40270	HOMME	0.0	18.8	110
40420	BYKLE - KULTRAN	0.0	23.6	156
40900	BJÅEN	0.0	27.0	182
41110	MANDAL II	0.0	34.2	246
41170	USLAND	0.0	20.8	99
41180	LAUDAL KRAFTSTASJON	0.0	17.8	100
41200	FINSLAND	0.0	18.5	122
41370	BJELLAND KRAFTVERK	0.0	20.4	143
41450	SKJERKA	0.0	29.7	230
41480	ÅSERAL	0.0	23.9	189
41550	LJOSLAND - MONEN	0.0	26.0	149
41640	VIGMOSTAD	0.0	21.9	115
41670	KONSMO - HØYLAND	0.0	23.4	152
41770	LINDESNES FYR	0.0	33.0	241
41820	KVÅVIK	0.0	29.0	160
41860	KVINESHEI - SØRHELLE	0.0	34.0	207
42160	LISTA FYR	0.0	29.6	152
42250	FEDAFJORDEN II	0.0	29.7	213
42350	GALLDAL	0.0	23.3	137
42520	RISNES I FJOTLAND	0.0	24.0	132
42650	FLEKKEFJORD	0.0	39.4	284
42720	BAKKE	0.0	25.4	148
42790	TONSTAD - FINSÅ	0.0	19.8	148
42810	TONSTAD - NETTFED	0.0	23.7	156
42890	SKREÅDALEN	0.0	27.1	189
42920	SIRDAL - TJØRHOM	0.0	25.5	148
42950	ØVRE SIRDAL	0.0	29.5	203
43090	JØSSINGFJORD			
43340	NORDRE EIGERØY	0.0	35.3	185
43360	EGERSUND	0.0	31.6	236
43450	HELLELAND	0.0	28.2	138
43500	UALAND - BJULAND	0.0	32.9	204
43540	ØRSDALEN	0.0	40.8	317
43810	MAUDAL	0.0	44.7	337
44150	NÆRBØ - SØYLAND	0.0	22.1	115
44160	HOGNESTAD	0.0	21.6	103
44240	TIME	0.0	33.0	167
44250	TIME - SKJÆRET	0.0	41.3	287
44290	SØR-BRAUT	0.0	20.7	115
44480	SØYLAND I GJESDAL	0.0	26.9	128
44520	HELLAND I GJESDAL	0.0	23.9	124
44560	SOLA	0.0	21.2	147
44600	RENNESØY - GALTA	0.0	26.5	180
44760	IMS	0.0	28.3	142
44800	SVILAND	0.0	23.9	115
44900	OLTEDAL	0.0	46.2	320

44960	MADLAND	0.0	35.4	451
45200	LYSEFJORDEN	0.0	45.3	375
45350	LYSEBOTN	0.0	57.4	382
45600	BJØRHEIM I RYFYLKE	0.0	35.7	209
45880	FISTER - TØNNEVIK	0.0	33.5	104
46050	ULLA	0.0	37.0	251
46150	SAND I RYFYLKE II	0.0	34.8	205
46200	SULDAL - MO	0.0	33.3	189
46300	SULDALSVATN	0.0	38.7	457
46400	NESFLATEN	0.0	39.2	467
46450	RØLDAL	0.0	32.1	334
46460	RØLDAL KRAFTVERK	0.0	29.8	271
46510	MIDTLÆGER	0.0	63.5	368
46610	SAUDA	0.0	29.6	153
46700	HELLANDSBYGD			
46850	HUNDSEID I VIKEDAL	0.0	60.8	400
46910	NEDRE VATS	0.0	39.8	220
47020	NEDSTRAND	0.0	39.8	248
47090	SKJOLD - FRØVIK	0.0	33.1	197
47200	SKUDENES II	0.0	31.0	59
47210	SKUDENES III	0.0	21.4	137
47240	KARMØY - BREKKEVANN			
47270	KARMØY - HYDRO			
47300	UTSIRA FYR	0.0	34.1	258
47390	HAUGESUND - ROSSABØ	0.0	25.3	97
47450	STRAUMØY	0.0	26.6	272
47500	ETNE	0.0	34.3	227
47600	LITLEDAL	0.0	37.9	383
47750	VINTERTUN	0.0	39.7	253
47820	EIKEMO	0.0	35.5	174
47890	OPSTVEIT	0.0	42.4	212
48050	BØMLO - FINNÅS	0.0	25.6	153
48090	LITLABØ - DALE	0.0	37.7	225
48160	BØRTVEIT PÅ STORD	0.0	55.0	277
48250	FITJAR - PRESTBØ	0.0	23.5	99
48330	SLÅTTERØY FYR	0.0	29.9	210
48390	UPSANGERVATN	0.0	35.5	236
48450	HUSNES	0.0	34.1	330
48500	ROSENDAL	0.0	34.1	166
48780	MAURANGER KRAFTSTASJON			
49070	KVÅLE	0.0	66.4	363
49350	TYSSEDAL I	0.0	56.7	607
49390	SKJEGGEDAL II			
49450	TYSSEDAL III			
49460	TYSSEDAL IV			
49550	KINSARVIK	0.0	28.5	243
49580	EIDFJORD - BU	0.0	42.4	370
49630	EIDFJORD	0.0	26.5	221
49750	LISET	0.0	30.7	177
49870	SIMADAL			
49940	GRANVIN	0.0	37.7	254
50050	NEDRE ÅLVIK	0.0	52.4	343
50080	ØYSTESE - BORGE	0.0	41.1	282
50120	SKULAFOSSEN KRAFTSTASJON	0.0	35.6	258
50130	OMASTRAND	0.0	33.4	213
50150	HATLESTRAND	0.0	39.9	270
50250	TYSSE	0.0	41.6	244
50300	KVAMSKOGEN	0.0	54.7	424
50350	SAMNANGER	0.0	50.4	372
50450	FANA - STEND	0.0	37.8	284
50540	BERGEN - FLORIDA	0.0	32.9	192
50860	GULLFJELL - OSAVANN	0.0	48.8	303
51100	FOSSE I BERGSDAL			
51130	KALDESTAD			
51250	ØVSTEDAL	0.0	53.2	338
51400	BREKKHUS	0.0	28.4	141
51470	BULKEN	0.0	28.2	117
51590	VOSS - BØ	0.0	27.7	181
51670	REIMEGREND	0.0	42.9	566

52110	FJELLANGER II	0.0	25.6	103
52170	EKSINGEDAL	0.0	28.5	139
52220	GULLBRÅ	0.0	23.5	132
52290	MODALEN II	0.0	38.3	206
52400	EIKANGER - MYR	0.0	34.9	192
52440	HOLSNØY - LANDSVIK	0.0	38.3	197
52530	HELLISØY FYR	0.0	26.0	155
52600	HAUKELAND	0.0	48.2	395
52640	MATRE KRAFTSTASJON	0.0	35.0	254
52750	FRØYSET	0.0	47.7	276
52860	TAKLE	0.0	48.6	334
52930	BREKKE I SOGN	0.0	56.7	283
52990	ORTNEVIK	0.0	40.6	377
53070	VIK I SOGN III	0.0	22.2	115
53080	VIK - VANGE	0.0	23.9	130
53100	VANGSNES	0.0	31.6	235
53130	FRESVIK	0.0	23.9	201
53160	JORDALEN - NÅSEN	0.0	30.9	245
53180	BRANDSET	0.0	31.6	196
53410	MYRDAL IV	0.0	48.4	321
53700	AURLAND	0.0	22.0	150
53730	GRIMSETE			
53950	AURLAND - ØYESTØL			
54130	LÆRDAL - TØNJUM	0.0	18.2	171
54320	BORGUND - LO			
54420	ØLJUSJØ PUMPEKRAFTVERK			
54500	BORLO	0.0	13.7	94
54600	MARISTOVA	0.0	16.8	97
54780	ØVRE ÅRDAL	0.0	22.9	160
54900	VETTI	0.0	30.9	236
55160	FORTUN	0.0	14.1	96
55170	SKAGEN	0.0	17.6	136
55270	SKÅLAVATN			
55390	LEIRDAL	0.0	42.2	344
55400	MYKLEMYR	0.0	24.0	171
55430	BJØRKEHAUG I JOSTEDAL	0.0	31.3	223
55550	HAFSLO	0.0	26.4	245
55670	VEITASTROND	0.0	25.1	161
55730	SOGNDAL - SELSENG	0.0	33.2	207
55840	FJÆRLAND - SKARESTAD	0.0	29.9	154
56010	HØYANGER VERK	0.0	36.3	285
56120	HØYANGSHÅLAND	0.0	23.6	142
56280	RØRVIKVATN VED VADHEIM	0.0	35.6	176
56320	LAVIK	0.0	40.0	219
56400	YTRE SOLUND	0.0	42.8	278
56480	VÆRLANDET	0.0	37.1	185
56520	HOVLANDSDAL	0.0	40.0	214
56560	GUDDAL	0.0	38.8	174
56650	DALE I SUNNFJORD II	0.0	45.0	241
56800	GAULAR	0.0	25.8	174
56850	VIKSDALEN I GAULAR	0.0	29.7	112
56960	HAUKEDAL	0.0	32.0	182
57110	OSLAND VED STONGFJORDEN	0.0	72.0	499
57190	FØRDE - VIE	0.0	38.5	215
57390	SKEI I JØLSTER	0.0	26.0	151
57480	BOTNEN I FØRDE	0.0	37.2	210
57610	GRYTA	0.0	56.1	259
57660	EIMHJELLEN	0.0	39.8	343
57680	EIKEFJORD	0.0	51.2	312
57770	YTTERØYANE FYR	0.0	35.8	250
57780	GRØNDALEN	0.0	62.8	433
57810	SVELGEN II	0.0	48.2	311
57850	DAVIKNES	0.0	43.2	293
57940	ÅLFOTEN II	0.0	56.9	281
57990	GJENGEDAL	0.0	39.2	254
58070	SANDANE	0.0	25.3	171
58120	KLAKEGG - BOLSET	0.0	27.0	177
58320	MYKLEBUST I BREIM	0.0	32.4	213
58400	INNVIK	0.0	21.7	119

58430	OLDEN - VANGBERG	0.0	24.3	130
58480	BRIKSDAL	0.0	30.4	206
58780	NORDFJORDEID - NYMARK	0.0	33.6	167
58880	SINDRE	0.0	24.3	150
58960	HORNINDAL	0.0	30.7	194
59200	ULVESUND	0.0	61.3	452
59450	STADLANDET	0.0	52.7	341
59560	BRANDAL	0.0	41.5	289
59610	FISKÅBYGD	0.0	38.9	346
59670	EKSET I VOLDA	0.0	27.7	213
59690	ØRSTA VEGSTASJON			
59710	ØRSTAVIK - VELLE	0.0	27.9	136
59800	SVINØY FYR	0.0	29.0	227
59900	SÆBØ	0.0	39.2	331
60210	STRANDA VEGSTASJON	0.0	30.6	292
60300	GEIRANGER	0.0	25.4	179
60400	NORDDAL	0.0	21.3	244
60500	TAFJORD	0.0	25.9	243
60620	GRØNNING	0.0	23.3	158
60710	STORDAL - OVERØYE	0.0	36.4	277
60800	ØRSKOG	0.0	48.4	210
60890	BRUSDALSVATN II	0.0	28.6	155
60970	ÅLESUND III	0.0	24.3	225
60990	VIGRA	0.0	26.1	160
61040	HILDRE	0.0	29.1	170
61100	VESTNES VEGSTASJON			
61170	HJELVIK I ROMSDAL	0.0	30.8	193
61350	ÅNDALSNES	0.0	28.6	260
61400	ÅNDALSNES VEGSTASJON			
61550	VERMA	0.0	15.2	82
61770	LESJASKOG	0.0	14.9	95
61820	ERESFJORD	0.0	26.2	140
61850	EIKESDAL	0.0	22.5	135
62160	ISTAD KRAFTSTASJON	0.0	30.5	228
62480	ONA II	0.0	32.3	284
62700	HUSTADVATN	0.0	34.8	175
62900	EIDE PÅ NORDMØRE	0.0	48.2	364
63100	ØKSENDAL	0.0	22.3	177
63420	SUNNDALSØRA III	0.0	25.1	265
63530	HAFSÅS	0.0	19.9	151
63580	ÅNGÅRDSVATNET	0.0	15.6	92
63590	KLETTHAMMER - SÆTEREN	0.0	23.4	225
63710	OPPDAL - BJØRKE	0.0	14.5	109
63750	MJØEN	0.0	16.3	104
64320	KRISTIANSUND ELVERK			
64460	HALSAFJORD II	0.0	33.8	205
64510	TINGVOLL GÅRD	0.0	22.2	147
64550	TINGVOLL - HANEM	0.0	21.6	148
64580	ÅLVUNDFJORD	0.0	27.1	170
64620	REINSET KRAFTSTASJON			
64700	INNERDAL	0.0	60.8	536
64780	SURNADAL - MOEN	0.0	23.1	158
64800	SURNADAL	0.0	18.8	151
64900	RINDAL	0.0	26.7	245
65100	VINJEØRA	0.0	28.0	145
65110	VINJEØRA II	0.0	26.6	183
65150	AUREDALEN	0.0	42.4	353
65220	HEMNE	0.0	35.8	246
65270	SØVATNET	0.0	24.3	204
65300	SKALMEN FYR	0.0	25.9	149
65370	SMØLA - MOLDSTAD			
65450	SANDSTAD	0.0	33.3	208
65600	HITRA	0.0	24.1	126
65940	SULA	0.0	21.6	139
66010	SELVA	0.0	26.2	156
66030	LENSVIK	0.0	23.4	151
66070	SKJENALDFOSSEN I ORKDAL	0.0	23.3	140
66100	SONGLI	0.0	29.6	181
66180	ORKDAL - ØYUM	0.0	13.5	65

66190	LØFTEN	0.0	15.8	110
66210	HOSTON	0.0	18.3	127
66250	HØLONDA	0.0	36.4	474
66580	NERSKOGEN II	0.0	19.0	121
66620	RENNEBU - RAMSTAD	0.0	20.9	147
66730	BERKÅK - LYNGHOLT	0.0	24.1	130
66850	KVIKNE I ØSTERDAL	0.0	18.5	149
67040	SKAUN - SYRSTAD	0.0	13.2	71
67050	SKAUN - ROSMO	0.0	14.1	111
67150	LEINSTRAND	0.0	14.9	72
67170	HAVDAL - OPPIGARD	0.0	16.6	105
67200	LUNDAMO	0.0	15.8	88
67240	STØREN - VÅRVOLL	0.0	15.8	88
67450	ENDALSVOLL	0.0	19.0	111
67540	RØSBJØRGEN	0.0	19.1	110
67770	HALTDALEN III	0.0	18.4	129
68000	BYNESET	0.0	18.2	163
68180	TRONDHEIM - NIDARVOLL	0.0	28.5	196
68270	LØKSMYR	0.0	19.4	157
68330	LIEN I SELBU	0.0	15.8	101
68340	SELBU - STUBBE	0.0	16.0	86
68420	AUNET	0.0	16.9	94
68450	NEA KRAFTVERK	0.0	18.9	118
68840	STUGUDAL - KÅSEN	0.0	24.5	155
69100	VÆRNES	0.0	15.5	80
69230	HEGRA II	0.0	21.4	138
69330	MERÅKER - KROGSTAD	0.0	24.8	200
69410	ROTVOLL	0.0	20.7	138
69470	KOPPERÅ	0.0	23.8	114
69550	ØSTÅS I HEGRA	0.0	22.9	122
69660	FROSTA - JUBERG	0.0	17.2	110
69960	BURAN	0.0	24.1	234
70120	VERDAL - STIKLESTAD	0.0	19.1	117
70150	VERDAL - REPPE	0.0	12.9	39
70340	VERDAL - SUL	0.0	18.9	132
70370	SULSTUA	0.0	23.4	146
70480	SKJÆKERFOSSEN	0.0	23.1	137
70500	VERA	0.0	20.5	95
70670	MÆRE			
70820	UTGÅRD	0.0	19.8	114
70850	KJØBLI I SNÅSA	0.0	24.4	236
71150	SELAVATN	0.0	29.1	167
71200	MOSVIK - TRØAHAUGEN	0.0	23.4	157
71280	LEKSVIK - MYRAN	0.0	23.3	107
71350	RISSA	0.0	20.5	128
71370	SLIPER	0.0	19.0	142
71550	ØRLAND III	0.0	24.6	151
71750	BREIVOLL	0.0	33.9	266
71810	ÅFJORD - MOMYR	0.0	36.4	227
71850	HALTEN FYR	0.0	19.8	131
71900	BESSAKER	0.0	30.0	225
71990	BUHOLMRÅSA FYR	0.0	23.0	134
72100	NAMDALSEID	0.0	25.5	180
72250	BANGDALEN	0.0	25.2	161
72650	OVERHALLA - UNNSET	0.0	21.4	162
73250	SØRLI	0.0	23.0	146
73500	NORDLI - HOLAND	0.0	15.4	59
73620	HARRAN	0.0	30.8	221
73800	TUNNSJØ	0.0	22.0	126
74160	RØYRVIKFOSS	0.0	18.8	90
74320	TRONES - TROMSSTAD	0.0	20.5	96
74510	SANDÅMO	0.0	25.5	158
74800	NAMSVATN	0.0	18.0	123
75020	OTTERØY	0.0	24.8	161
75100	LIAFOSS	0.0	33.9	225
75150	VAL LANDBRUKSSKOLE	0.0	27.0	195
75270	RØRVIK - ENGAN	0.0	21.9	137
75410	NORDØYAN FYR	0.0	20.0	112
75550	SKLINNA FYR	0.0	22.4	153

75600	LEKA	0.0	26.0	181
76100	ØKSNINGØY	0.0	33.7	209
76250	SØMNA - STEIN	0.0	24.6	120
76270	TRÆLNES	0.0	31.2	194
76380	SAUSVATN - SKOGMO	0.0	36.3	260
76450	VEGA - VALLSJØ	0.0	33.7	238
77270	FALLMOEN	0.0	26.3	211
77290	SVENNINGDAL	0.0	27.3	203
77420	MAJAVATN III	0.0	26.9	195
77510	FIPLINGDAL II	0.0	24.8	156
77750	SUSENDAL - BJORMO	0.0	23.7	134
77850	SUSENDAL	0.0	22.3	112
78100	DREVJA	0.0	36.8	212
78250	LEIRFJORD	0.0	42.9	267
78350	BARDAL	0.0	31.5	253
78420	KORGEN - AURINGMOEN	0.0	29.4	176
78610	TUSTERVATNET II	0.0	25.8	137
78770	FAMVATNET	0.0	18.2	84
78850	RØSSVATN - HEGGMO	0.0	27.8	128
79480	MO I RANA III	0.0	34.3	348
79530	RANA - BÅSMOEN	0.0	30.9	219
79640	GRØNLIGROTTEN	0.0	33.6	293
79670	RØVASSDALEN	0.0	25.1	172
79710	GRØNFJELLDAL	0.0	28.3	166
79740	DUNDERLANDSDALEN	0.0	38.3	402
80100	NORD-SOLVÆR	0.0	32.6	174
80200	LURØY	0.0	59.6	302
80340	TRÆNA - HUSØY			
80350	TRÆNSTAVEN			
80650	HALSA I HELGELAND	0.0	34.1	176
80700	GLOMFJORD	0.0	36.8	195
80850	SUNDSFJORD	0.0	43.0	275
80950	TENNHOLMEN FYR	0.0	25.7	122
81080	BEIARN - NAUSTVOLD	0.0	25.3	205
81250	LEIRÅMO	0.0	29.3	179
81360	BØRNUPVATN			
81370	OLDEREID KRAFTSTASJON	0.0	29.4	248
81680	SALTDAL	0.0	13.6	102
81730	JUNKERDAL	0.0	24.3	169
81770	LØNSDAL	0.0	21.6	132
81900	SULITJELMA	0.0	38.9	285
81930	STORSTILLA			
81940	COARVE			
81950	BALVATN			
82160	HEGGMOEN VED BODØ			
82290	BODØ VI	0.0	26.5	136
82560	KJERRINGØY - STRANDÅ	0.0	31.9	215
82650	VALLJORD			
82800	KOBBELV	0.0	62.2	303
82840	STYRKESNES - HESTVIKA	0.0	38.6	261
83300	STEIGEN	0.0	31.5	193
83500	KRÅKMO	0.0	38.8	334
83520	TØMMERNESET	0.0	37.0	249
83550	FINNØY I HAMARØY	0.0	29.5	185
83880	SØRFJORD KRAFTVERK	0.0	32.8	183
84070	BJØRKÅSEN	0.0	28.5	127
84170	SKJOMEN - SLETTJORD	0.0	19.8	119
84190	SKJOMEN - STIBERG	0.0	23.2	164
84450	ANKENES	0.0	26.7	135
84800	NARVIK III	0.0	25.0	212
84960	LILAND	0.0	26.8	148
85060	KANSTADBOTN IV	0.0	50.7	372
85180	RINBØ	0.0	27.5	191
85200	YTTERSTAD	0.0	20.6	114
85380	SKROVA FYR	0.0	19.8	120
85440	KVITFOSSEN I VÅGAN			
85470	KONGSMARKA			
85540	LEKNES I LOFOTEN	0.0	38.1	247
85660	REINE	0.0	81.1	698

85910	RØST II	0.0	19.4	130
86470	SØRKLEIVDALEN	0.0	27.6	156
86500	SORTLAND	0.0	26.4	197
86760	BØ I VESTERÅLEN II	0.0	25.0	117
86850	BARKESTAD	0.0	26.7	126
86950	ALSVÅG I VESTERÅLEN II	0.0	21.5	130
87110	ANDØYA	0.0	26.8	139
87350	BORKENES	0.0	17.4	225
87550	ERVIK	0.0	18.4	107
87750	GAUSVIK			
87860	GROVFJORD			
87940	GRATANGEN III	0.0	25.5	163
88000	TENNEVOLL	0.0	28.8	185
88100	BONES I BARDU	0.0	24.7	117
88350	TRANØYBOTN II	0.0	26.1	140
88460	GRUNNFARNES	0.0	30.8	171
88660	BOTNHAMN	0.0	25.5	183
88690	HEKKINGEN FYR	0.0	22.4	144
89110	MÅLSELV - GRUNDNES	0.0	24.0	128
89350	BARDUFOSS	0.0	15.4	107
89500	SÆTERMOEN II	0.0	19.8	106
89650	INNSET I BARDU			
89800	ØVERBYGD	0.0	17.7	80
89950	DIVIDALEN	0.0	15.7	149
90080	MESTERVIK	0.0	16.1	95
90200	STORSTEINNES I BALSFJORD	0.0	14.9	78
90450	TROMSØ	0.0	13.9	83
90490	TROMSØ - LANGNES	0.0	13.0	76
90570	LYFJORD	0.0	23.5	151
90650	GRUNNFJORD - STAKKEN	0.0	25.3	164
90800	TORSVÅG FYR	0.0	21.6	109
90900	FUGLØYKALVEN FYR	0.0	16.1	98
91110	ULLSFJORD II	0.0	20.0	176
91250	LYNGSEIDET III	0.0	15.7	89
91300	OTEREN	0.0	28.3	275
91370	SKIBOTN - FOSSBAKK	0.0	26.2	188
91400	SKIBOTN KRAFTVERK			
91440	HELLIGSKOGEN MILITÆRLEIR	0.0	19.0	123
91520	MANNDALEN	0.0	16.1	111
91600	GUOLASJÅKKA KRAFTVERK			
91700	SKJERVØY - KOBBEPOLLEN	0.0	51.1	350
91750	NORDREISA	0.0	61.4	748
91760	NORDREISA - ØYENG	0.0	22.3	150
91930	REISADALEN - BJØRKLI	0.0	16.5	142
92210	KVÆNANGSBOTN II	0.0	18.3	160
92350	NORDSTRAUM I KVÆNANGEN	0.0	16.3	132
92700	LOPPA	0.0	34.5	258
92750	HASVIK LUFTHAVN			
92900	LANGFJORDBOTN	0.0	23.7	168
93140	ALTA LUFTHAVN	0.0	14.7	141
93300	SOLOVOMI	0.0	16.6	127
93500	JOTKAJAVRE	0.0	13.3	75
93650	BIDJOVAGGE	0.0	26.6	158
93710	KAUTOKEINO II	0.0	16.7	104
93900	SICCAJAVRE	0.0	21.6	231
94130	PORSA II	0.0	25.9	151
94180	SKAIDI	0.0	20.9	109
94500	FRUHOLMEN FYR	0.0	32.6	192
94700	HELNES FYR	0.0	28.1	188
94800	REPVÅG	0.0	20.8	176
95270	SKOGANVARRE II	0.0	15.7	108
95350	BANAK	0.0	15.9	118
95610	BØRSELV - HØGBAKKEN	0.0	20.1	115
95900	VEIDNES I LAKSEFJORD	0.0	16.9	122
96000	ADAMSELV KRAFTVERK	0.0	17.3	100
96220	LEBESBY - KARLMYHR	0.0	19.2	171
96400	SLETNES FYR	0.0	20.4	134
96800	RUSTEFJELBMA	0.0	19.1	142
96930	POLMAK	0.0	15.1	101

96970	SIRMA	0.0	16.0	99
97110	PORT	0.0	12.2	67
97150	VALJOK	0.0	14.1	95
97250	KARASJOK	0.0	13.1	90
97320	JERGUL	0.0	10.0	67
97350	CUOVDATMÅKKI	0.0	8.8	50
97580	MOLLISJOK	0.0	15.5	126
97690	ISKURASJOK	0.0	17.5	194
98060	BERLEVÅG - BAKKETUN	0.0	33.6	330
98400	MAKKAUR FYR	0.0	19.7	96
98550	VARDØ	0.0	24.3	198
98650	SKALLELV	0.0	20.0	144
98850	VESTRE JAKOBSELV	0.0	17.3	137
99100	GANDVIK	0.0	21.6	154
99330	VEINES I NEIDEN	0.0	23.5	284
99370	KIRKENES LUFTHAVN	0.0	12.4	92
99450	BJØRNSUND	0.0	14.3	136
99500	SKOGFOSS	0.0	15.9	173
99530	PASVIK	0.0	22.3	279
99690	LANABUKT	0.0	24.3	259
99710	BJØRNØYA			
99720	HOPEN			
99760	SVEA GRUBER	0.0	18.1	140
99840	SVALBARD LUFTHAVN	0.0	13.0	101
99910	NY-ÅLESUND			
99950	JAN MAYEN			